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ABSTRACT

This document, a curriculum guide for auto mechanics for secondary students, is one of six guides developed for inservice teachers at Marianas High School in Saipan. The guide provides the rationale, description, goals, and objectives of the program: the program of studies and performance objectives by levels: samples of lesson plans for effective delivery of instruction: and a listing of references. Concepts covered include definition of power, craftsmanship and safety, career opportunities, metric and American standard systems of measurement, tools, fasteners, energy sources and power, aspects of energy transfer, explanation of combustion including some basic physics, heat engines, operations, types, principles and design, and support systems for common internal combustion engines. Appended are lesson plans for teaching power mechanics, engine design and theory of operation (AC generator), engine overhaul and service, electrical system, welding, body fender and painting, lubricating system, and cooling system. (CT)

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ED203096

CURRICULUM GUIDE

Mechanics
Secondary Schools

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FOREWORD

This document, Curriculum Guide for Mechanics is one of several guides developed during the 1980 Summer Session held for in-service teachers at Marianas High School in Saipan. The in-service workshop was made possible through a federal project titled, Vocational Education Personnel Development in the Pacific Basin, under Section 135 of Title II of the Education Amendment Act of 1976 (P. L. 94-482).

Experienced teachers and administrators representing the secondary schools of the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands developed the guide to establish curriculum standards for vocational education in their respective school systems. It is hoped that this guide will help teachers and administrators improve instruction as well as establish a base for future curriculum development efforts.

The guide provides the rationale, description, goals and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references.

Constructive comments and recommendations will be appreciated. These should be forwarded to either the Department of Education, Commonwealth of the Northern Mariana Islands or Bureau of Education, Trust Territory of the Pacific Islands, Directors of Vocational Education.

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This Curriculum Guide for Mechanics is the result of the cooperative efforts of many people in the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the University of Hawaii. Experienced teachers, in cooperation with the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and University of Hawaii, have contributed toward the development of this guide. The following persons are acknowledged as participants, consultants, evaluators, and support staff for the development of this guide.

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INTRODUCTION

Rationale

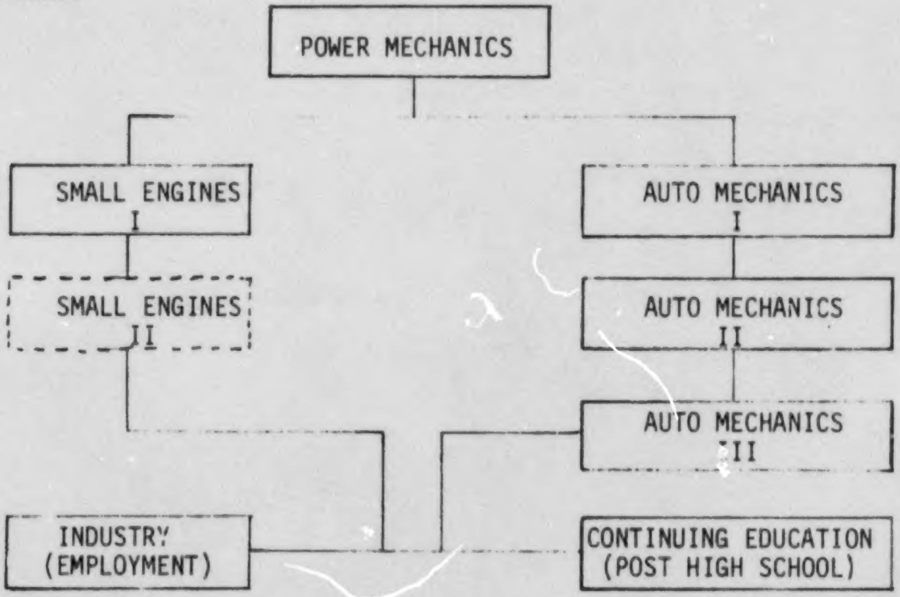
The Mechanics Program is the study of converting energy into power, which contributed a great deal to the progress and development of our society. By harnessing power, it became a useful product for our everyday lives.

Within the past few years, the use of power for Automotive Engines, Small Engines, and Diesel Engines increased at a great rate in both the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands which created a great demand for well trained mechanics. As a result of this urgent need, this Curriculum Guide for Mechanics was developed.

Program Description

This Curriculum Guide for Mechanics was developed at a summer workshop composed of vocational educators from throughout Micronesia. The Guide reflects the diverse needs of CNMI and TTPI.

In order to fulfill these goals, courses were developed and articulated as follows:



NOTE: At the present time, there is no articulation between Small Engine I and Small Engine II.

In order to insure student interest and program completion, this sequentially development program is being proposed. This curricula is modeled after successful vocational programs in that courses are designed to help student progress up the career ladder in the fields of Mechanics.

Program Goal

The goal of this program is to provide a well articulated, yet flexible series of courses which will enable students to either pursue a program at the postsecondary level or go on directly into industry with entry level job skills.

In addition, the program will provide participants with skills necessary for becoming productive individuals and knowledgeable consumers.

Program Objectives

1. Develop an insight and understanding of power mechanics technology and its place in our culture.
2. Provide career development experiences in power mechanics technology.
3. Develop knowledge and skills required in the power mechanics trades.
4. Prepare students for employment and/or advance studies in power mechanics technology.
5. Develop an understanding of the proper use and maintenance of tools and equipment associated with power mechanics.
6. Develop a sense of civic responsibility.

PROGRAM OF STUDIES

POWER MECHANICS

A. COURSE TITLE: POWER MECHANICS

B. COURSE DESCRIPTION

This course is designed as a semester course for the 9th grade (Freshman) level. It is a study of the fundamental concepts of energy and power, how they relate to mankind and the field of mechanics. Utilizing shop work and demonstrations, field trips and resource speakers, class lectures and demonstrations, including testing and evaluation, the students will explore topics such as: definition of power, craftsmanship and safety, career opportunities, metric and American standard systems of measurement, tools, fasteners, energy sources and power, aspects of energy transfer, explanation of combustion including some basic physics, heat engines, operations, types, principle and design and support systems for common internal combustion engines.

C. GOAL

It is the goal of this course to develop interest and introduce students to the field of mechanics technology.

D. OBJECTIVES

1. Develop an understanding and appreciation for quality craftsmanship, including: proper background knowledge and work attitudes, use of tools, facilities, equipment, supplies and safety awareness.

2. Develop an awareness of career opportunities in the area of power technology.

3. Develop an understanding of origins and natural available forms of energy.

4. Develop an understanding of historical and future perspectives in harnessing energy for increasing the quality of life style.

5. Develop a basic understanding of power control enabling the student to identify, assess, and evaluate efficiency of different systems.

6. Provide students with basic mechanical understanding, enabling them to move easily into related courses.

7. Develop an understanding of the fundamental physical aspects of the combustion process as it relates to common engines.

8. Develop an understanding of the principal components and operation of internal combustion engines presently common throughout Micronesia and Commonwealth of the Northern Mariana Islands.

COURSE OUTLINE

UNITS:

I. Introduction/Orientation:

- A. Instructor's brief background
- B. Definition of "Power Mechanics"
- C. Facilities
- D. Course Requirements
- E. Safety
- F. Career Opportunities

II. Basic Hand Tools:

- A. System of measurement
- B. Tools
  1. Wrenches
  2. Pliers
  3. Screwdrivers
  4. Cutting tools
  5. Impact tools
  6. Cleaning tools
  7. Measuring tools
  8. Pullers
  9. Specialized tools

III. Fasteners:

- A. Types
  1. Bolts
  2. Nuts
  3. Machine screws
  4. Sheetmetal screws
  5. Washers
- B. Thread Fundamentals:
  1. Metric & American thread pitch system
  2. Thread pitch gauge
  3. UNC & UNF thread series

C. Fasteners Characteristics:

    1. Class of fit
    2. Dimensions
    3. Strength

D. Fastener Torque:

    1. Procedures
    2. Pattern & sequence
    3. Specifications

E. Threads Process & Repair

    1. Internal & external threading process
    2. Repair procedures

IV. Energy Orientation:

A. Energy Sources:

    1. Original & Indirect
    2. Interrelationships
    3. Characteristics
    4. Forms

B. Man's Harnessing of Energy:

C. Measurement of Energy:

    1. Fundamental of Kinetic energy:

       force, mass, volume, momentum,pressure, velocity
       distance & friction

    2. Calculation & Interrelationship of kinetic energy:

       torque, work, mechanical power, horsepower

    3. Measurement of other energy forms:

       Electrical: Volts, ohms & amps
       Nuclear: rods, rems
       Light: illuminess & candle-power
       Heat: calories & BTU

D. Energy Transfer

    1. System: hydraulic, pneumatic, mechanical
    2. Aspects of Efficiency

V. Basic Engine Principle & Design

A. Explanation of Combustion

1. Engine definition
2. Internal & external combustion

B. Basic Phusics Theories

1. Three stages of meter
2. Physics definitions: Elements, chemical analysis, mixture, mechanical process, basic substance, molecules, cohesion, adhesion, chemical change, oxidation, density, atoms, combustion, compression.

C. Internal Combustion Engine

1. Basic operation
2. Types: turbine, jet and piston
3. Motion
4. Otto cycle
5. Components
6. 2/4 cycle operation
7. Other Ice operation: diesel, rotary, etc.
8. Support systems: fuel, lubrication, cooling, and ignition

Unit: I. INTRODUCTION/ORIENTATION - POWER MECHANICS I

Major Objective: Upon completion of this unit, the students will have developed the fundamental understanding of and interest in the Power Mechanics field. In addition, they will be aware of attitudes associated with success in this program.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Instructor's brief background	1. Review and discuss importance of experience in instructor's background	1. Discussion-(field experience & educational experiences)
2. Definition of "Power Mechanics"	2. Define the words "Power Mechanics"	2. Discussion and notes on the board
3. Facilities	3. Identify, locate, explain and demonstrate the usage of all available facilities	3. Touring the facilities, lecture and demonstration of usage
4. Course Requirements	4. Discussion and define all the requirement for this course (student booklet, attendance, shop & class work, tests & quizzes	4. Lecture with handouts on safety, demonstrations - syllabus
5. Safety	5. Demonstrate, identify & explain the differences between safe and unsafe shop practices	5. Lecture, handouts on safety demonstrations and quiz

Unit: II. BASIC HAND TOOLS

Major Objective: At the completion of this unit, the students will have a broad understanding of the proper use and maintenance of basic mechanics hand tools.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. System of Measurement	1. Identify measurement as given in either Metric or American Standard, define and compare Metric & American volume, linear and weight measurement units Breakdown the metric measurement system from kilometer to a millimeter and American standard from 1" to 1/64". Relate historical development of both systems of measurement Compare and contrast both systems	1. Examine samples which incorporate both systems, i.e. tools, containers, rules... Color coded overlay transparencies and charts and handouts Lecture/discussion Discussion
2. Tools	2. Identify, explain sizing, state advantages, safety rules, and display proper selection and use and maintenance aspects of 68 out of 75 hand tools	2. R & R a variety of fasteners on expendable shop aids (see appendix # II.2.)

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
		Each student to work as a tools keeper during shop work Discuss handout for tools

Unit: III. FASTENERS

Major Objective: At the completion of this unit, the students will have acquired a broad understanding of various fastening devices associated with the mechanics industry.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Fastener Types	1. Identify, state advantages & disadvantages, display proper selection and use of 15 fastening devices	1. Ref: Auto Service & Repair, Chapter 3 - outline handout for student notes, lecture transparencies, shop demonstration on the use of all fasteners (see appendix # III.1.)
2. Thread Fundamentals	2. Explain both Metric & American systems of thread pitch Demonstrate use of thread pitch gauge Define UNC and UNF thread series	2. Ref: Zelenda Fastener Charts, transparencies- Ref: Automatic Mechanics Ch. 4 Demonstration, lecture & Discussion

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
6. Career Opportunities	6. List and define 15 job opportunities associated with the field of Mechanics Explain attitudes associated with quality craftsmanship in mechanic's fields	6. Notes on board, lecture on local and outside careers, field trips: public works, local repair shops, etc. Discussion and guest speaker(s) from related areas: parts, maintenance, jet mechanic, heavy equipment mechanic, marine engineer, etc.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Fastener Characteristics	3. Explain class of fit	3. Ref: Zelenda Fastener Chart, Automotive Mech., Ch. 4 and/or Auto Service & Repair-Ch. 3
	Illustrate 4 major dimensions used to classify fasteners	
	Determine and explain uses of different strenth fasteners	
4. Fastener Torque	4. Explain steps of fastener torquing	4. Ref: Zelenda Fastener Chart, Auto-Mechanics, Ch. 4, and/or Auto Service & Repair, Ch. 3, Lecture and demonstrations
	Explain torque pattern and sequence, indicating standard patterns when no manual is available	Class, homework & Demonstration
	Locate torque specification in a standard mechanic's manual, given shopwork problems	Shopwork, demonstration, quizzes & test
	Torque a set of fasterners properly	Ref: Auto Services & Repair, Chap. 1
5. Thread Process and Repair	5. Describe both internal and external threading process	5. Ref: Auto Services & Repair, Ch. 1 Demonstration, shopwork, lecture
	Demonstrate internal threading process	Ref: Automotive Mech., Ch. 6
	Describe the renewal of a broken stud including 6 contingency plans	Demonstration

Unit: IV. ENERGY ORIENTATION

Major Objective: Upon completion of this unit, the students will have developed an understanding of the major aspects of energy and its relationship to mankind.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Energy Sources	1. List and define original energy and indirect energy sources Illustrate and define interrelationship of all energy sources Explain nature of energy available and the law of conservation Explain the 3 energy forms: Latent, Active and Potential	1. Ref: Small Gasoline Engine, Ch. 1 - Power Mechanics of Energy Control, Ch. 1 & 7 Automotive Mechanics, Ch. 9 Lecture, transparencies, charts, handouts and quizzes.
2. Man's Harnessing of energy	2. Describe the historical development of the harnessing of evergy for man's use	2. Ref: Power Mechanics of Energy Control, Ch. 1 & 2 -lecture, transparencies, charts handouts and quizzes

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Measurement of Energy		
Fundamental Aspects	Define, describe interrelationship and give examples of: Force, Mass, Volume, Momentum, Pressure, Velocity, Distance and Friction	Ref: Power: Mechanics of Energy Control, Ch. 1 & 2
Measurement, Calculations & interrelationship of Mechanical energy	Calculate H.P. using the prony brake & dynomometer methods	Shop experiment to measure H.P. using simple prony brake method
	Calculate H.P., pressure, force torque, work, mechanical power from given examples	Practice math problems, handout using (appendix # IV. 3.b.1.)
Measurement of other energy forms:	For the following: define, describe and show interrelationship of:	Charts and handouts of schematic, comparison/descriptions, lecture, discussions, transparencies and quizzes
Electrical	Volts, Ohms and Amps	
Nuclear	Rads and Rems	
Light	Illumines and candle power	
Heat	Calories and BTU	
4. Energy Transfer		
Systems	Describe hydraulic, pneumatic and mechanical transfer systems	Ref: Power: Mechanics of Energy Control, Ch. 3

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Efficiency Aspects	Identify problems associated with energy transfer Describe/ define efficency List different methods of transporting kinetic & potential energy and evaluate them using efficiency as a criterion	Lecture, transparencies, shopwork demonstrations and quizzes

Unit: V. BASIC ENGINE PRINCIPLE & DESIGN

Major Objective: At the completion of this unit, the students will have developed the basic knowledge which is needed to understand different engine designs and the principles of operation. In addition, they will have acquired a fundamental understanding of basic physical processes associated with power production.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Explanation of combustion	1. Define the word "Engine" Explain and define combustion Compare and contrast internal and external combustion engine	1. Ref: Small Gasoline Engines, Ch. 2,- Automotive Mechanics, Ch. 9, lecture, handouts, transparencies and quizzes
2. Basic Physics	2. Identify and describe the three states of matter and their interrelationship Describe and/or define elements, chemical analysis, mixture, mechanical process, basic substances, molecules, adhesion, chemical change, oxidation density, atoms,	2. Lecture, handouts, discussions and quizzes

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Describe how heat effects basic substances	
	Describe three methods of initiating combustion	
3. Internal Combustion Engine		
Basic Operation	Demonstrate how to use information acquired in the previous unit by developing a combustion engine model	Lecture, discussion, handouts, transparencies and quizzes
Motion	Describe 3 types of motions and illustrate interrelatedness	Lecture and discussion on motion
Otto Cycle	Illustrate 5 events associated with piston engine power production	Discussion - chart on Otto Cycle
2&4 Cycle engine Variations	Compare/contrast & explain 2 cycle and 4 cycle engine operations	Handouts - 2&4 cycle charts, lecture and discussions on differences and similarities
Nomenclature	Identify and describe purpose of 25 components central to the operation of reciprocating piston engines	Handouts and discussions - example on test (appendix # V.3.e.)
Types and Variations	Describe and relate basic operational principles of; turbine, jet and piston engines	Small Gasoline Engines, Ch. 2
4. Support Systems	4. Identify major components and explain the operation of these 4 support systems: Fuel System, Ignition System, Cooling System lubrication System	4. **Small Gasoline Engines**, Ch. 2 8, and 9 - lecture, shopwork on disassemble and reassemble small engines (both 2 & 4 cycle), transparencies, charts and quizzes

AUTO MECHANICS I

A. COURSE TITLE: AUTO MECHANICS I

B. COURSE DESCRIPTION

An exploratory course emphasizing basic skills, which will lead to a series of courses and terminate with a job entry skill. Its content area will be basic principle and theory of operation, nomenclature, basic construction, and operation of variouse types of automotive engines, fuel systems, ignition systems, electrical systems, suspensions, power trains, and accessories.

C. GOAL

It is the goal of the Automotive Mechanics I to provide learning situations and experiences for the students to become aware, interested, and develop skills about the basic principle and operation of the automobile.

D. OBJECTIVE

1. Develop insight and understanding of an automobile and its place in our culture.
2. Develop a basic understanding of automotive engine and the basic components of the automobile.
3. Prepare the student for the Auto Mechanic II course.
4. Develop student's interest in pursuing his study in the area of Auto Mechanics.
5. Develop basic skills in proper use of common industrial tools, equipment, and measuring tools.
6. Develop the knowledge and skills of a safe working habit in the shop.

E. OUTLINE

I. Orientation

A. Facilities

1. Equipment
2. Personnel Duty Station
3. Automotive Manuals

B. Instructional Materials

1. Objectives
2. Information
3. Assignment
4. Evaluation

II. Safety

- A. Terms and definition
- B. Color Code
- C. Personal Safety Rules
- D. General Shop Safety Rules
- E. Types of Fires
- F. General Shop "Housekeeping"

III. Tools Measurement and Fasterners

- A. Basic hand tools
  1. Importance
  2. Care
  3. Selection
- B. Measurement
  1. Measuring tools
  2. Reading Measurement
  3. Use of measuring tools
- C. Fasterners
  1. Types
     - a. self-tapping/sheet metal screws
     - b. machine screw and hold
     - c. studs
     - d. self-locking nuts
     - e. lock washer
     - f. rivets
     - g. set screw

IV. Engine Design and Theory of Operation

- A. Nomenclature
- B. Four Stroke Cycle
- C. Engine Types
- D. Valve Arrangement

V. Lubrication System
    A. Principles and operation
    B. Oil pump
    C. Oil filter
    D. Oil pressure bypass
    E. Oil cooler
    F. Oil contamination and care
    G. Oil consumption
    H. Crankcase ventilation
    I. Friction
    J. Oil Classification
    K. Oil viscosity

VI. Cooling System
    A. Function
    B. Construction
    C. Operation
    D. Maintenance

VII. Fuel System
    A. Types of fuel systems
    B. Fuel tank
    C. Fuel line
    D. Fuel pump
    E. Fuel filter
    F. Carburetor
    G. Air cleaner
    H. Fuel gauge
    I. Manifold

J. Exhaust Systems

K. Gasoline

L. Terms

VIII. Ignition System

A. Types

1. Magneto
2. Breaker point ignition system
3. Electronic ignition system

IX. Electrical

A. The theory of operation

B. Voltage

C. Current

D. Resistance

E. Ohm's law

F. Conductor

G. Insulator

H. Magnetism

I. Battery

J. Generator

K. Alternator

L. Regulator

M. Starter Motor

N. Horn

O. Relay

P. Switch

X. Suspension

A. Suspension

1. Control linkage assy
2. leaf spring suspension
3. coil spring suspension

B. Manual steering system

1. recirculating ball nut type
2. rack and pinion type

C. Basic theory operation of the brake system

XI. Power Train

A. Types of Transmissions

1. Gear Ratio
2. Construction and operation
3. Types of Synchronizers

B. Drive Lines

1. Propeller Shaft
2. Universal Joint
3. Differential Housing

C. Rear Axle Assemblies

1. Types
2. Construction
3. Bearings and Differential

D. Clutches

1. Definition and Function
2. Construction of Disc
3. Construction of Pressure Plate
4. Release Lever Operation
5. Linkage and Clutch Pedal

XII. Accesories

A. Lighting System

B. Fuses

C. Radio

D. Windshield Wiper

E. Windshield Washer Motor

F. Windshield Wiper Motor

G. Speedometers

H. Horn and horn relay

Unit: I Orientation Auto I

Major Objective: After the completion of this unit, the student should be able to locate the tools, equipment, and rooms. The student will be able to describe and identify the personal information and the instructional materials of this unit.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Orientation of the building and its equipments will help the students to be familiar with the location of the tools, equipment, and the rooms.	1. Explain and identify the location of the tools, equipment, and rooms in the Auto-shop.	1. Tour the shop.
a. Show the operation procedure of the stationary equipment.	1a. Demonstrate the use of the equipment.	1a. Take a test on tool and identification of the equipment. Demonstrate the operation of the equipment.
b. Auto-shop and personnel duty station.	1b. Identify and name the areas of personnel duty station.	1b. Lecture on personnel duty station.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
c. Automotive manuals	1c. Identify and use auto-manuals to check the specifications.	1c. Demonstrate the use of the manuals.
2. Instructional Materials	2. Explain and identify the purpose and the use of instructional materials.	2. Listen to the lecture on the purpose of it.
a. Objective sheet	2a. Read the objective sheet.	2a. Discussion and lecture on objective sheet.
b. Information sheet	2b. Study the information sheet.	2b. Discussion and lecture on information sheet.
c. Assignment sheet	2c. Complete the assignment sheet	2c. Read the text and complete assignment sheet.
d. Test	2d. Score at least 80% on the unit test.	2d. Review on the test.

Unit: II Safety Auto I

Major Objective: Upon completion of this unit, the student will have developed knowledge toward keeping a shop orderly, clean and safe.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Terms and definition	1. List in writing, and define the three terms given.	1. Give students terms to study.
2. Colors and application of safety color code	2. List in writing, apply, and understand the six color codes with statement of their use.	2. Lecture
3. Personal safety rules	3. Prepare safety rules & demonstrate in the lab.	3. Lecture & demonstration
4. General shop safety rules	4. Prepare, understand, & demonstrate any general shop safety rules given.	4. Lecture & demonstration students participate in lab.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
5. Types of fires	5. List four types of fire extinguishers . Select from a list of fire extinguishers the type best suited to extinguish each class of fires.	5. Lecture & demonstration
6. Disposal of combustible material & keeping supplies in proper place.	6. Explain how & where to store combustible materials.	6. Lecture & demonstration. Give test on. 1. Terms to define 2. Color code 3. Personal safety 4. Shop safety rules 5. Types of fires

Unit: III Tools, Measurement and Fasteners - Auto I

Major Objective: Upon completion of this unit, the student will have developed an understanding of the basic hand tools and a variety of fastening devices and systems common to Automotive Mechanics. In addition, they will understand the Metric and American Standard systems of measurement and apply all of this acquired knowledge to shop activities.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Basic Hand Tools	1a. Select top quality tools	1a. lecture
a. Importance of tools	1b. Arrange & keep tools clean	1b. lecture & demonstration
b. Proper care	-Sort tools out so they will be easy to locate	
c. Selection of tools	1c. Demonstrate how each tool is used	1c. lecture & demonstration
	-Identify each tool shown to them	
	-Select proper tool for job.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
2. Measurement		
A. Measuring Tools	2a. Identify 5 different types of measuring tools -Break-down the metric system to one millimeter and the American system to 1/64".	2a. lecture
B. Reading Measurement	2b. Demonstrate the ability to read all five of the rules when given or point at a specific unit	2b. lecture & demonstration
C. Use of Tools	2c. Measure objects and construct lines when given any of the five measuring rules.	2c. Teacher demonstrate students participate by writing on board. -Give Test
3. Types of Fasteners	3. Identify 5 different types of fasteners -Giving five different jobs the student will be able to choose the proper fastener	3. lecture
A. Self-tapping or sheet metal screw	3a. Demonstrate how to fasten sheet metal parts together -Demonstrate by attaching various items to sheet metal	3a. Teacher demonstrate students participate in lab.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
B. Machine screw and bolt	3b. Describe & explain the difference between bolt, machine screw, & sheet metal screw	3b. lecture
C. Studs	3c. Define stud bolts -Differentiate studs sizes by sight -Perform proper steps in removing studs without ruining the threads	3c. lecture & demonstration -students participate in lab
D. Self-locking nuts	3d. List & identify 4 different types of self locking nuts	3d. lecture & demonstration
E. Lock washers	3e. List & identify 4 different type of lock washers	3e. lecture & demonstration
F. Rivets	3f. Describe the method used to install a rivet	3f. lecture & demonstration
G. Set screw	3g. Describe & identify location where set screw are used	3g. lecture -Take identification test on the different types of fasteners

Unit: IV ENGINE DESIGN & THEORY OF OPERATION AUTO I.

Major Objective: After completion of this unit, the student will be able to list the characteristics and types, and define the operation of four cycle internal combustion engines.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Nomenclature & functions of engine parts	1. Explain the function & relationship between pistons, rings, crankshaft, valves & cylinders.	1. Text, films, engine parts
2. The four stroke cycle	2. Explain the four stroke principle & operation.	2. Lecture Film: OF AUTO ACTION
3. Engine types	3. Differentiate engine types	3. Film: COMBUSTION IN ACTION Lecture
4. Valve Arrangement	4. Explain & discuss types of valve arrangement	4. Listen to lecture & discussion on valves arrangement. Read-Text on course, Chapter - 5.

Unit: V Lubrication System Auto I

Major Objective: At the end of this course, the student will be able to list, describe, identify, and understand different types of oil, pumping systems, problems, and types of filters used in lubrication systems.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Principles and operation of the lubrication system:	1. Explain the construction and types of lubrication systems:	1. Lecture on the types of system, principles and operation.
a. friction	1a. Explain the principles of lubrication.	
2. The oil pump.	2. Identify types of oil pumps. -Explain the location and drive of each pump. -Explain how to service various type of oil pumps.	2. Lecture and demonstrate each oil pumps. -View on film strips.

LUBRICATION SYSTEM (continued)

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. The function of oil filter.	3. Identify various types of oil filters. -Explain how the oil filter work. -R & R oil filters.	3. Lecture on oil filters -Student participation R & R oil filter.
4. Oil pressure bypass.	4. List and explain the components of the bypass valves. -Describe how oil pressure and bypass works.	4. Lecture by using chart and board. -Read textbook for valve lubricating. -View overhead transparencies.
5. Oil coolers	5. Identify and describe a oil cooler.	5. Lecture with diagram. -View overhead transparencies of oil coolers. -Read the textbook on oil cooler.
6. Contamination of oil	6. List places where oil is kept -Describe the oil in the shop. -Explain why oil is changed.	6. Read the textbook about keeping oils. -Lecture and demonstrate.

LUBRICATION SYSTEM (continued)

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
7. Oil consumption	7. Define the oil consumption. -Trace the oil leaks from an engine. -Describe how the engine leaks oil.	7. Read textbook about oil comsumption. -Lecture with transparencies on oil consumption. -Lecture on seal locations.
8. Crankcase Ventilation and changing oil	8. Identify the oil ventilation. -List the reasons for oil ventilation.	8. Lecture on oil ventilation.
	9. Describe friction problems regarding heat, parts wears, and other problem friction caused. Describe and identify how friction can be reduced by lubrication system.	
10. Oil application and Classification.	10. Describe and identify two types of oil classifications. -Describe the difference between the new API oil classification and previous API oil classification.	10. Lectures on these two oil classification systems. -Present to the students from a reference oil chart.
11. Oil viscosity.	11. Describe and explain the importance of oil viscosity.	11. Read chapter in text and reference books relating to oil viscosity. Participate in class discussion and lecture on oil viscosity and oil change.

Unit: VI COOLING SYSTEM AUTO I

Major Objective: After the completion of this unit, the students will be able to define the characteristics of the Cooling System

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Function	1. Define and explain the purpose of the cooling system	1. Read text and reference books on the cooling system
2. Construction	2. Explain and define how the cooling system operates	2.3 Listen to and take part in lecture and discussion on Auto-Engine
3. Operation	3. Demonstrate the proper operation of each components	
4. Maintenance	4. Apply the proper maintenance procedures	4. Identify additives of cooling system

Unit: VII FUEL SYSTEM AUTO I

Major Objective: After completion of this unit, the student should be able to identify the components of fuel system, and explain the operation of each. The student should be able to remove, disassembled, reassemble all types of carburetors. He should be able to make all necessary adjustment on any given carburetor. He also should be able to service all the components of the fuel system. This knowledge will be proven through demonstration and by scoring 90% of the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Types of fuel systems	1. Explain the difference between gasoline fuel system from the other types of fuel systems. Describe the different types of fuel systems	1. Lecture on the difference between gasoline fuel system, diesel fuel system, OPG fuel system. On cars, show the student the different type of fuel system
2. Fuel Tank	2. Locate and replace a gas tank of any given car	2. Explain to the student the different location of the gas tank of different types of car
3. Fuel Line	3. Repair any broken gas line on any given car. Identify the types of fuel line	3. Name different type of tubes that can be used for fuel line. Demonstrate how to repair a fuel line and show them what tools must be used

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Use the right tools in repairing the fuel line	
4. Fuel Pump	4. Name three types of fuel pump	4. Name the different type of fuel pump
	Repair all types of fuel pump	Demonstrate how to repair each type of fuel pump
	Explain the operation of fuel pump	Explain to the student how fuel pump operates
5. Fuel Filter	5. Identify the four types of fuel filters	5. Show to the student the four types of fuel filter & state the application of each types
	Describe the operation of fuel filter	
6. Caburetor	6. Identify the different types of carburetors	6. Explain to the student the different types of carburetors
	Identify the carburetors' component	Name the component of carburetor & give the function of each part
	Explain the function of all carburetors component	Demonstrate how to service & repair carburetors
	Repair any given carburetor	Show how to make the final adjustment on a carburetor
	Explain the operation of carburetor	
	Make any necessary adjustment on the carburetor	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
7. Air Cleaner	7. Identify the three types of air cleaners	7. Show to the student the three types of air cleaners & give the application of each type
	Service & repair all the three types of air cleaners	
	Explain the purpose of air cleaner	Demonstrate how to service the three types of air cleaners
8. Fuel Gauge	8. Identify the two types of fuel gauges	8. Explain to the students the two types of fuel gauges
	Explain the operation of fuel gauge	
	Service the fuel gauge	Demonstrate how the gauge work, & how to service the fuel gauge
9. Manifold	9. Identify the difference between intake & exhaust manifold	9. On a car, show to the student the difference between intake & exhaust manifold
	Explain the operation	Show them the manifold
10. Exhaust System	10. Identify exhaust pipes	10. On a car, show the students what is exhaust system.
	Identify various types of muffler system	Show them how to replace a muffler
	Explain the function of exhaust system	Lecture on different types of exhaust systems

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
11. Gasoline	11. Explain how gasoline is made Identify gasoline from other types of fuel Should explain why regular gasoline is not recommended to use in some type of gasoline engine	11. Explain to the student how to obtain gasoline from the ground Explain to them the different types of gasoline, and the application of each type
12. Terms	12. Define the following terms: Atomization Metering Evaporation Knocking Head of Compressor Venturi Pre-ignition Volatility Detonation	12. Write on the board the meaning of the given term Go over the word with the students

Unit: VIII IGNITION SYSTEM AUTO I

Major Objective: After the end of the unit, the student should be able to describe, identify and list three types of ignition, also theory of operation, and functions of the component. This performance knowledge will be evidenced by scoring 85% on the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Types of ignition system:	1. Describe & identify the various parts & function of each component	1. Lecture - Student read text & reference books - View diagram
a. Magneto	1a. Describe basic theory of operation of magneto system	1a. Show to the student on engine equip with magneto system
b. Breaker-Point	1b. Describe & identify basic function of the components in the breaker-points ignition system	1b. Lecture - Student read text - View wall chart - Show sample of breaker-point ignition system
C. Electronic	1c. Describe & identify the component of the electronic ignition system - Describe basic function of the electronic ignition system - Differentiate between breaker-points system & electronic system	1c. Lecture - View diagrams - Student participation in the lab. - On a car, show to the student an electronic ignition system

Unit: IX ELECTRICAL SYSTEM AUTO I

Major Objective: Upon the completion of this unit, the student will be able to explain the basic operation of the electrical system.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. The Electron Theory	1-1 Explain what is electricity	1. Lecture on electron theory
	1-2 Define electrons	
2. Voltage	2-1 Define voltage	
	2-2 Explain how to measure voltage	2. Lecture on voltage
	2-3 Explain the importance of voltage in the electrical system	
3. Current	3-1 Explain what is current of electricity	3. Lecture on electricity
	3-2 Give the unit of measuring electricity	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Resistance	4-1 Define resistance	4. Lecture on resistance
	4-2 Give the unit of measuring resistance	
5. OHM's Law	5-1 Explain the Ohm's law in its three forms	5. Lecture on Ohm's law
	5-2 Solve any given problem by using Ohm's law	Practice solving problem using Ohm's law
6. Conductor	6-1 Explain what is conductor	6. List on a board the material that are good conductors
	6-2 Explain how electrons move through a conductor	- Show some sample of good conductors
		- Explain why they are good conductors
	6-3 Explain why only few types of material are good conductors	
7. Insulator	7. Explain what is an insulator	7. Name some materials that are good conductors
		- Show some samples
8. Magnetism	8-1 Explain how magnet is used to produce electricity	8. Lecture on different types of magnet
	8-2 Explain the two different types of magnet	- Explain how magnet help produce electricity
9. Battery	9-1 Explain the purpose of a battery on a vehicle	9. Lecture on the battery
	9-2 Describe how the battery is constructed	- Show a battery to the students
	9-3 Name the parts of the battery and give the function of each part	- Explain battery construction

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	9-4 Explain how to maintain a battery	- Show how to use hydrometer
	9-5 Explain how to test a battery by using hydrometer	
	9-6 Explain how battery produce electricity	
10. Generator (DC)	10-1 Explain the basic principles of a DC generator	10. Lecture on generator construction & basic principles of operation
	10-2 Identify the generator's parts & give the function of each part	- Show to the student a working generator
	10-3 Identify generator from alternator	
	10-4 Identify the two generator's circuits	
11. Alternator (AC Generator)	11-1 Explain the alternator construction	11. Lecture on alternator construction & operation
	11-2 Explain its basic principles of operation	- Show them an alternator
	11-3 List the advantage of an alternator over a generator	- Lecture on why an alternator is better than a generator
12. Regulator	12-1 Explain the basic principles of regulator	12. Lecture on basic operation of regulator
	12-2 Identify alternator's regulator from generator's regulator	- Deomonstration on how different types of regulator work
	12-3 Explain how each of the two types of regulators work	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
13. Starter Motor	13-1 Explain the basic operation of a starter motors	13. Lecture on starter motor construction and operation
	13-2 Identify the starter motor's components	
	13-3 Explain the three types of drive pinion	- Show the three types of drive pinion
	13-4 Explain how the starter solenoid operates	- Show them a solenoid & explain its operation
14. Horn	14. Draw a horn circuit using a relay & explain its operation	14. Lecture on the horn
		- Demonstrate how to wire a horn circuit using a relay
15. Relay	15-1 Explain the purpose of relay	15. Lecture on construction & operation of relay
	15-2 Explain how relay work	- Show a relay to the students
16. Switch	16. Identify different types of switches	16. Lecture
		- Show to the student the different types of switches use on a car

Unit: X SUSPENSION AND BRAKES AUTO I

Major Objective: After the completion of this unit, the student will be able to explain the purpose, function, and operation of the suspension and the brakes system. This will be evidenced through demonstration and scoring 90% on the unit exam.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Suspension		
a. Control linkage assy.	1a. Identify the various parts in the control linkage assy. Describe the parts functions of the control linkage assy. Name the parts of the control linkage assy.	1a. Lecture Demonstration Student read study guide P. 148
b. Leaf spring suspension	1b. Give functions and different types of spring suspension. Explain the different types used depending on car weight. Explain how the leaf spring suspension is attached and how it works.	1b. Lecture Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
c. Coil spring suspension	1c. Identify & give functions of parts on the coil spring suspension	1c. Lecture Demonstration Student read text on coil spring suspension
	- Show the different locations of coil spring suspension on cars	
2. Manual steering system		
a. Recirculating ballnut type	2a. Explain the function and operation of the steering system	2a. Lecture Demonstration
b. Rack and pinion type	2b. Describe the difference between a recirculating ballnut type and rack and pinion type	2b. View film on steering system
3. Basic theory and operation of the brake system	3. Explain the purpose, construction and operation of the automotive brakes Differentiate between drum and disk brakes Discuss the purpose of antilock devices and how they work	3. Lecture Demonstration Experiment with model

Unit: XI POWER TRAIN Auto I

Major Objective: After completion of the Unit, the student should be able to identify all the parts that transmit the power from the transmission to the wheels. The students will be able to list all the major parts of the Power Train.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
1. Types of Transmission	1. Identify the types of transmission.	1. Demonstrate the types of transmission
a. Gear Ratio	1a. Identify and count the number of gears in the transmission and mathematically compute gear ratio.	1a. Lecture on the gears in transmission.
b. Construction & Operation	1b. Explain the construction & operation of transmission.	1b. Lecture and demonstrate the construction and the operation of the transmission.
c. Types of synchronizers	1c. Describe the difference between the types of synchronizers.	Lecture on the types of synchronizers.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
2. Drive Lines	2. Identify all the parts of the drive lines.	2. Demonstrate and observe the parts of the drive lines.
a. Propeller shaft	2a. Explain the connections between the transmission output shaft and the differential joint gear shaft.	2a. Lecture on the propeller shaft and its connection.
b. Universal Joint	2b. Explain the purpose of using universal joint.	2b. Lecture on the universal joint.
c. Differential housing	2c. Identify and name all the parts of the differential housing.	2c. Observe and lecture on differential housing.
3. Rear Axle Assemblies	3. Identify all the parts of the rear axle assemblies.	3. Observe and demonstrate the parts.
a. Types of axles	3a. Identify the three basic types of axles.	3a. Lecture on the three basic types of axles.
b. Construction of the axles	3b. Explain the construction of the axles.	3b. Read text and reference material.
c. Bearings and differential	3c. Identify the parts that consist of differential carriers and two large bearing holders that support the spinning differential case.	3c. Lecture on differential carrier and bearings.
4. Clutches	4. Identify all the parts of the clutch system.	4. Observe the clutch system.
a. Definition & function of the clutch	4a. Explain the definition and the function of the clutch.	4a. Read text and reference material.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Clutch disc construction	4b. Explain how clutch disc is constructed.	4b. Lecture on the clutch construction
c. Construction of pressure plate assembly	4c. Identify and describe the types of the pressure plate and explain the various number of springs which is used.	4c. Lecture on the clutch disc.
d. Clutch release lever operation	4d. Describe the operation of the clutch release lever.	4d. Listen to lecture on the operation of the clutch release lever.
	4d. Describe the movement of the clutch disc during its operation.	
e. Linkage nand clutch pedal	4e. Identify all the links, levers, and rods connected between the clutch pedal and throw-out fork.	4e. Demonstrate and draw the links, levers and rods connections on the board.

Unit: XII ACCESSORIES Auto I

Major Objective: After the completion of this unit, the student should be able to identify and locate each of the accessories and also list or explain the operation of each unit. The student should be able to troubleshoot and do repair work on all the accessories. This knowledge will be evidenced through demonstration and by scoring 90% on the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Lighting system	1. Replace the head lamp and tail light on any given car. Explain the operation of head light.	1. Lecture on the operation of head light. Demonstrate how to replace head lamp.
a. Signal light	1a. Replace the signal light on any given car.	1a. Demonstrate how to replace the turn signal. Lecture on the function of signal light.
2. Fuses	2. Locate the fuse box and identify the different fuses for different circuit.	2. Lecture on the purpose of different types of fuse. Show the student the different places on a car where the fuse box is located.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Radio	3. Locate the radio on any given car.	3. Show to the student the car radio and where it is located.
4. Windshield Wiper	4. Replace a windshield wiper on any given car.	4. Show to the student how to replace a wiper on a car. Do it on a car.
5. Windshield Washer Motor	5. Locate and replace the washer motor.	5. Take the student to the car and show them the motor and how to replace it.
6. Windshield Wiper Motor	6. Find the motor on any given car.	6. Lecture on the operation of windshield wiper motor and types of motor used on different cars.
	Explain the operation of the motor.	
	Any repair work on any type of windshield wiper motor and switch.	
7. Speedometers	7. Explain the function of speedometer.	7. Explain the operation of speedometer.
	Take off the speedometer cable and put new one on.	Demonstrate how it work and how to replace the speedometer cable.
8. Horn and Horn Relay	8. Explain the operation of horn and horn relay.	8. Lecture on the operation of horn and horn relay.
	Replace horn	Demonstrate on a car how to replace horn and horn relay.
	Replace horn relay	

AUTO MECHANICS II

A. COURSE TITLE: AUTO MECHANICS II

B. COURSE DESCRIPTION

This course is designed for the student who has a basic knowledge of engine theory of operation which is covered in Auto Mech. I.

This course will cover the application for the principles involved in servicing and repairing the automobile engine. Emphasis is placed on preventive maintenance, engine overhaul, electrical system, basic tune-up, brake and tires service and use of tools for proper job.

C. GOAL

Upon successfully completion of this course the student will be able to seek employment and or further his education.

The student should have the basic knowledge, understanding, and skills which will enable him to experience, understand, and appreciate the challenges he will face today and tomorrow.

D. OBJECTIVES

1. Develop knowledge and understanding of the principles, concept, and problems of industrial technology.

2. Apply tecnnical knowledge which will enable him to seek employment.

3. Develop appreciation of the skill which will enable him to contribute successfully to the technological society.

4. Develop understanding which will enable him to further his education.

E. COURSE OUTLINE

UNIT I ORIENTATION

A. Instructor background

B. Course content

C. Review Auto I content

D. Facilities Introduction

UNIT II SAFETY

A. Personal safety

B. General shop safety

C. Tools safety

D. Machinery safety

E. Equipment safety

F. First aid

UNIT III Tools and Measurement

A. Micrometer

  1. Micrometer part
  2. Function of each part

B. Special Tools

  1. Thickness gauge
  2. Spark plug gauge
  3. Pressure gauge
  4. Pulleys
  5. Caliper
  6. Honer

C. Vacuum Gauge

  1. Read gauge
  2. Calibrate the instrument

D. Dial Indicator

  1. Purpose
  2. Types

E. Torque Wrench

  1. Purpose
  2. Reading inch pound to foot pound

F. Engine Tachometer

  1. Proper way to use tach
  2. Purpose
  3. Test

UNIT IV ENGINE OVERHAUL AND SERVICE

A. Valve Service

  1. Visual inspection of valve
  2. Valve spring tension
  3. Valve & seats grinding specs.
  4. Valve seal removal
  5. Valve inspection of push rod
  6. Installation of push rod
  7. Replacing of valve guides
  8. Cleaning of parts
  9. Valve installation
  10. Reassemble of rocker arm

B. Valve Timing

  1. Specs of valve duration
  2. Installation of timing chain
  3. Valve timing chain/gears
  4. Visual inspection of worn parts

C. Cylinder Head

  1. Cylinder head removal
  2. Visual inspection for cracks
  3. Replacing of head cylinder
  4. Installation of cylinder head and tighten with torque to specs.

D. Manifold

  1. Removing and replacing of manifold

     a. Intake
     b. Exhaust

E. Camshaft

F. Valve Adjustment

  1. Solid lifter valve adjustment
  2. Hydraulic lifter adjustment

G. Piston and Rods

  1. Piston & rod removal
  2. Remove of ridges
  3. Visual inspection of piston
  4. Replacing of piston rings
  5. Installation and removal of piston pin
  6. Alignment of con-rods

7. Visual inspection of piston pin
8. Visual inspection of rod-bearing
9. Checking fitness of con-rod bearing
10. Installation of piston in cylinder
11. Check piston gap clearance in cylinder
12. Check ring gap in cylinder

G. Oil Pan

1. Removal and installation of oil pan

H. Crank Shaft

1. Replace crankshaft
2. Check crankshaft journal gap
3. Check main bearing for condition
4. Replace main bearing
5. Check crankshaft end play
6. Installation of crankshaft

I. Cylinder Block

1. Visual inspection
2. Hone cylinder
3. Check cylinder wear
4. Replace expansion plugs
5. Remove and install vibration damper

J. Oil Pump

1. Service oil pump according to specifications

K. Distributor

1. Service distributor
2. R & R distributor
3. Replace spart plug

L. Water Pump

1. Visual inspection
2. R & R water pump

UNIT V ELECTRICAL SYSTEM

A. Charging System

1. Function of the charging system
2. Battery

- a. Function of battery
- b. Battery construction
- c. Electrolyte
- d. Cell voltage
- e. State of charge

3. Alternator
   - a. Function of the alternator
   - b. Types of alternator
   - c. Operation
   - d. Disassemble for defective parts
   - e. Test for ground, open, short and assemble of repair
   - f. Four major components of the alternator

4. Troubleshooting the Charging System
   - a. Battery low in charge
   - b. Low output of the alternator
   - c. High output of the alternator
   - d. Test battery and alternator circuit resistance
   - e. Test alternator output
   - f. Adjust alternator cut out and regulator

B. Starting System

1. Function of starting system
2. Ignition switch
3. Starter relay
4. Starter selenoid
5. Starter drive
6. Disassemble and assemble for defective parts
7. Test the armature, commutator, and field coil for ground, open, and short

UNIT VI TUNE-UP

A. Basic Purpose of Tune-up

1. Why tune up is necessary
2. Comprehensive tune-up
3. Complete tune-up

B. Tools for Tune-up

1. Name of tools

C. Tune-up Procedures

   1. Compression testing, troubleshooting and reading

      a. Steps for preparing the engine for testing

   2. Zero the gauge
   3. Repeat cylinder readings
   4. Evaluate results
   5. Further results evaluation

      a. Steps for symptoms with interpretations

D. Vacuum Gauges Readings

   1. Normal
   2. Leaking piston
   3. Late timing
   4. Leaking intake
   5. Leaking head gasket
   6. Carburetor out of adjustment
   7. Incorrect spark plug gap
   8. Defective valve action

E. Spark Plugs

   1. Heat range
   2. Conditions

F. Distributor Service

   1. Breaker point and condenser

      a. Procedure for cleaning, inspections, replacement, and installment

   2. Secondary inspections

      a. Same as F-1-a

   3. How to use dwell-tach for trouble reading

G. Ignition Timing

   1. Timing use
   2. Static timing

H. Carburetor

   1. Idle
   2. Other

UNIT VII BRAKE - TIRE - WHEELS

A. Brakes

  1. Hydraulic - the Science of liquid in motion
  2. Master cylinder and wheel cylinder

    a. Master cylinder
    b. Wheel cylinder

  3. Brake Adjustment

    a. Manual adjustment
    b. Self adjusting

  4. Parking brake adjustment

  5. Shoe and lining replacement

    a. Remove brake shoe
    b. Cleaning, inspection, installing new shoes

  6. Wheel Cylinder and overhaul

    a. Remove and disassembled
    b. Inspection
    c. Installation

  7. Bleeding and Flushing

    a. General information
    b. Bleeding master cylinder
    c. Bleeding wheel cylinder

B. Wheels and Tires

  1. Tires

    a. Bias
    b. Radial
    c. Tire balance
    d. Thread design
    e. Tire wear
    f. Mixing tire on the car
    g. Rotating tire

  2. Wheels

    a. Wheel alignment
    b. Caster and camber
    c. Tow in and tow out

3. Wheel Bearing

   a. Inner wheel bearing
   b. Adjusting wheel bearing
   c. Greasing wheel bearing

Unit: I Orientation Auto II

Major Objective: Upon completion of this unit, student will be aware of the requirement set by the course syllabus.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Instructor background	1. Show appreciation for instructors background through attentiveness.	1. Lecture - discussion
2. Course Content	2. Understand course requirements and content.	2. Lecture using syllables
3. Review Auto I Content	3. Exhibit knowledge of Auto I materials by passing broad test on selected Auto I content, scoring no lower than 75%.	3. Test - Remedial work for those failing
4. Facilities Introduction	4. Identify, locate, demonstrate and explain proper use of facilities.	4. Two facilities - demonstrate - lecture - discussion

Unit: II Safety Auto II

Major Objective: Upon completion of this unit, student will identify, explain and demonstrate safe shop practice and attitudes. Give a written test, the student will score 100%.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
	List & demonstrate daily:	
1. Personal Safety	1. Rules regarding personal safety.	Handout, transparency, lecture, discussion.
	Ex. Clothing, eye protection	
2. General Shop Safety	2. Rules regarding general shop	View film
	Ex. Safety, no horse play, cleanliness	Test
3. Tool Safety	3. Rules regarding tool safety	
	Ex. Organization, correct use of tools	
4. Machinery Safety	4. Rules regarding machinery safety	
5. Equipment Safety	5. Rules regarding shop equipment	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Ex. Electrical connection, guards left practices	
6. First Aid Kit	5. Rules regarding first aid	

Unit: III Tools and Measurements Auto II

Major Objective: The student will develop the skill and knowledge on tools and measurements to successfully overhaul an engine

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Micrometer	1. Identify parts of the micrometer	1. Lecture & demonstration
	Compute various measurements using a micrometer.	
	State the functions of each part	
2. - Special Tools	2-a Measure certain clearances with the thickness gauge	2-af lecture text, demonstration
a-Thickness gauge b-Spark plug gauge c-Pressure gauge d-Pulleys e-Caliper f-Honer	2-b Demonstrate one spark plug gaping	2-df lecture text
	2-c Show various use of pressure gauge on hydraulic brake, fuel pump, etc,.	View a film on special tools
	2-d Demonstrate the use of pulleys	
	2-e State the functions and identify part of caliper	
	2-f Show the proper way of honing a cylinder and give the procedural steps of honing	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Vacuum Gauge	3. Identify part of the gauge	3. lecture text demonstration
	3.1 Demonstrate various type of tests.	
	3.2 Show the proper way to caliprate the instrument.	
4. Dial Indicator	4. Demonstrate the obligation of dial indicator on engine and to measure end play, backlash, wear, alignment and out of round in thousandths of an inch.	4. Lecture, demonstration view a film on dial indicator
5. Torque Wrench	5. Indicate the purpose of torque wrench	5. Demonstration lecture
	5.1 Show the various type of torque wrenches	
	5.2 Specify the common type of torque wrench used	
	5.3 Indicate that the readings are in ft, lb, in. lb., and metric.	
6. Engine Tachometer	6. Show the proper way of taking the reading	6. Demonstration
	6.1 Indicate the purpose of the tachometer	Lecture
	6.2 Utilize some tests with the tachometer.	

Unit: IV Engine Overhaul & Service Auto II

Major Objective: After the completion of this Unit, the student should be able to do a major overhaul of any type of reciprocating engines. He should be able to do inspection and checking of an engine component to determine whether they need to be serviced or replaced. He should be able to work on the cylinders and grind the values and value seats. This knowledge will be evidenced by scoring ninety percent on the Unit test and successfully complete or finish overhaul on engine. The engine must be run good.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Value Service	1. Remove the valves	Lecture
	1.1 Inspect the valves for burning and benting or sticking	Demonstration
	1.2 Checking valve spring for proper tention and squareness.	Lab. work (Practical work in the shop)
	1.3 Replace valve seats inserts.	
	1.4 Grind the valve and valve seats within the given spec.	
	1.5 Check push-rod for end wear and straightness	
	1.6 Install the push-rod	
	1.7 Replace valve guides on removable type	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	1.8 Keep the part clean during reassembling of the engine	
	1.9 Install the valves	
	1.10 Remove, clean and reassemble the rocker arm assembly, provided it is in good condition.	
2. Valve Timing	2. Time the valves so they open and close at the right time. Follow specifications.	
	2.1 Remove and install the time chain	
	2.2 Time the valve regardless whether engine is using gears or chain	
	2.3 Inspection of worn parts	
3. Cylinder Head	3. Remove the head in a proper way	Lecture
	3.1 Clean and inspect the cylinder head for crack and damages	Demonstration
	3.2 Replace the cylinder head within the manufacture specifications.	Lab: spend more time
	3.3 Install the head tightening the bolts in the right sequence and torque which is given in the specification.	
4. Manifold A. Intake B. Exhaust	4. Remove and replace manifold on all types of vehicle	Lecture

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
5. Camshaft	5. Remove the camshaft from the engine on all types of vehicle	Lecture
	5.1 Remove the camshaft from the engine	Lecture
	5.2 Use the dial indicator to check the shaft for alignment	Lab
	5.3 Inspect the cam wear	
	5.4 Replace the camshaft bearing	
	5.5 Install the camshaft	
6. Valve Adjustment	6. Adjust the valve lash on any engine equipment with solid valve lifters	Lecture Demonstration
	6.1 Adjust the valve tappet clearance any engine with hydraulic valve lifters.	
7. Piston & Rods	7. Remove the pistons and rods from the cylinders	Lecture and Demonstration
	7.1 Use ridge cutters to remove the ridge from the cylinders	Lab.
	7.2 Clean and inspect the pistons for sear.	
	7.3 Replace the piston rings	
	7.4 Remove and install the piston-pin on all three types of piston pins.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	7.5 Check the connecting rods for alignment	
	7.6 Check the connecting-rod bearing fit.	
	7.7 Install the pistons into the cylinders	
	7.8 Check the pistons diameter and how they fit in the cylinders	
	7.9 Check for piston ring gap	
8. Oil Pan	8. Remove and install the oil pan	Lecture
9. Crankshaft	9. Replace the crankshaft	Lecture
	9.1 Checking the crankshaft journals for wear	Lab
	9.2 Determine whether the main bearing could be changed or not	
	9.3 Replace the main bearing	
	9.4 Check for crankshaft end play	
	9.5 Installation of crankshaft	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
10. Block	10. Clean & inspect the block for crack	Lecture
	10.1 Hone the cylinder	
	10.2 Check the cylinder for wear	
	10.3 Replace expansion plugs	
	10.4 Remove expansion plugs	
	10.5 Remove & install vibration damper	
11. Oil Pump	11. Service oil pump according to specs.	Lecture and Lab.
12. Distributor	12. Service, R & R Distributor	Lecture
	12.1 Set the distributor so spark plugs will fire at the right time	Demonstration
		Lab
13. Water Pump	13. Replace water pump	Lecture and Lab.

Unit: V Electrical System Auto II

Major Objective: After completion of this Unit, the student should be able to identify and explain the functions of the components or the parts of the electrical system. The student will be able to disassemble, repair, assemble, test or troubleshoot the parts of this system without any assistance from the instructor.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
I. Charging System	1. Identify all the parts of the charging system	1. Demonstrate and lecture and observe
A. Function of the charging 1. Function of the battery 2. Battery construction 3. Electrolyte 4. Cell voltage 5. State of charge	1.1 Explain the function of the charging system	Lecture and read text
	1.2 Explain the function of the battery	Lecture and read text
	1.3 Describe the construction of the battery	Lecture and text.
	1.4 Describe the solution that make the electrolyte	Lecture and text
	1.5 Explain or tell the number of voltage produce in each cell	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Explain the specific gravity and equivalent open circuit voltage readings and show the various states of charge by percentage.	Lecture and text
B. Alternator	B. Identify the types of alternator	B. View filmstrips and slides
1. function of the alternator and name some	B-1 Explain the function of alternator and name some of the types of alternator.	Lecture and observe
2. types of alternators	B-2 Describe the operation of the alternator	Lecture and read text
3. operation	B-3 Disassemble and check for defective parts	Demonstrations
4. disassemble for defective parts	B-4 Use testers to check the internal parts of the alternator for ground, open, and short	Demonstrations
5. Test for ground, open, short and assemble after repaired		
C. Troubleshooting the charging system	C. Troubleshoot the components of the charging system	C. Demonstration, lecture
1. Battery low in charge	C-1 Explain the reasons why batteries become discharged and list down some of the indications a battery is low in charge	Lecture and read text
2. Low output of the alternator		
	C-2 List some of the problems that caused low output alternator	Lecture and text

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. High Charge rate	C-3 Describe the indications that point to the high charge rate	3, Lecture and text
4. Test Alternator Circuits Resistance	C-4 Test the resistance of the alternator circuit by using the tester	4, Demonstration
5. Test Alternator Output	C-5 Check the alternator output by using a tester and find out the standard automotive alternators rated capacity	5, Demonstration
6. Adjust Alternator Cut-out and Regulator	C-6 Adjust alternator cutout and regulator by using accurate instruments	6, Demonstration and lecture
D. Starting System	D. Identify and explain the functions of all the components or parts of the starting system	D, Read text and lecture
1. Function of the Starting System		
2. Ignition Switch	D-1 Explain the function of the starting system	Lecture and text
	D-2 Differentiate the positions of the ignition switch and name two circuits that the battery voltage is applied during starting position	Lecture and Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Starter Relay	D-3 Explain the means of energizing the starter by connecting the battery to the starter motor and when the starter control circuit is closed	3. Lecture and demonstration
4. Starter Solenoid	D-4 Explain the solenoid by means of engaging the starter drive with the engine wheel.	4. Lecture and demonstration
5. Starter Shaft	D-5 Identify the two common types of starter drives	5. Lecture and demonstration
6. Disassemble for cleaning and checking defective parts	D-6 Disassamble the starter for cleaning and check for defective parts	6. Demonstration
7. Commutator, Field Coil and Armature	D-7 Use a tester to check the commutator, field coil and armature for ground, short and open	7, Demonstration
8. Assemble the starter motor after repaired the defective parts	D-8 Assemble the starter motor in the correct way of assembling the starter motor after repaired the defective parts.	8. Demonstration

Unit: VI TUNE-UP Auto II

Major Objective: After the completion of this Unit, the student should be able to describe, identify, and list tune-up procedures, types of tools and their functions. The students will be able to troubleshoot and services any vehicle.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Basic tune-up	1. Describe the importance of basic purpose of tune-up and necessary aspect of tune-up.	1. Read chapter in text manuals. Participate in class discussions.
2. Comprehensive tune-up	2. Describe and identify certain step to be covered during comprehensive tune-up.	2. Read chapter in text and ref. in manuals and instructions. Participate in class discussions. Experiment with component.
3. Complete tune-up	3. Identify and describe all steps with each components part to be covered during a complete tune-up	3. Perform demonstration in the complete tune-up steps. Participate in class discussions.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Tune-up tools	4. Identify and describe all types of tools with their main function.	4. Experiment with the components
Name of tools		Perform demonstration
		Participate in class discussions
5. Tune-up procedures	5. Describe, identify steps used in engine preparation for test.	5. Experiment with components
Comprehension test		Perform demonstration about the use of tools.
		Experiment with the tools
		Perform demonstration for tool used
6. Vacuum gauge reading	6. Identify and describe the main function of vacuum gauges.	6. Read the textbook reference
Normal Leaking piston	Identify and describe the reading of normal & leakage problems of vacuum gauges.	Perform demonstrations
7. Late timing	7. Identify and describe late timing of engines.	7. Read textbooks
		Perform experiments
8. Leaking intake	8. Describe the cause of intake leakage.	8. Read textbook.
	Describe how to correct the problem.	Perform experiment
		Class discussions

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
9. Leak cylinder head	9. Describe and identify what causes the cylinder head leakage.	9. Class Discussions Read text chapters Perform experiments Perform experiments
10. Carburetor Adjustments	10. Identify and describe the function of the carburetor in general. Describe the correct way of adjusting carburetor.	10. Read textbooks and references. Participate in class discussions. Perform experiments
11. Spark plugs gaps incorrect	11. Describe and identify incorrect spark plug gaps. Describe how to adjust spark plug to correct gaps.	11. Read textbook and references Perform demonstrations
12. Defective Valve Action	12. Identify and describe the valve action. Identify the defective valve	12. View valves in action Perform experiments
13. Spark Plugs A. Heat Range B. Spark Plug Readings	13. Identify and describe 3 types of spark plug heat ranges. Identify the differences in construction of each type Identify and describe color and conditions of spark plugs using spark plug reading chart.	13. Draw diagram of spark plug showing each part. Read chapters in text and references Read chapter in text and references book relating to spark plug charts.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Decribe how to remove, replace spark plugs using correct tools.	Perform demonstrations
	Describe when to replace spark plugs according to the mileage.	Participate in class discussions.
14. Distributor Services	14. Identify and describe how to clean inspect, replace the breaker points.	14. Perform demonstrations
A. Breaker Point		Participate in class discussion
15. Secondary Inspections	15. Describe and identify the secondary components by using metal to test low resistance of the circuit	15. Experiment with the components
		Participate in class discussions
		Read text and references
16. How to use dwell-tach	16. Identify and describe how to use dwell-tach	16. Perform demonstrations
		Participate in class discussions
		Experiment with components
17. Ignition Tune-up	17 Identify and describe the procedure on engine timing.	17. Perform demonstrations
A. Timing light	Describe how to use timing light	Read textbook and references
B. Static tuning	Identify and describe the procedures in static timing	Experiment with components
		Participate in class discussions
		Read text and references

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
18. Carburetor Adjustments	18. Describe and identify different parts of the carburetor to be adjusted.	18. Perform demonstrations
Idle	Describe the importance of the carburetor adjustments	Participate in class discussions
		Experiment with the components

Unit: VII Brakes - Tires - Wheels Auto II

Major Objective: At the end of this Unit, the students will be able to do, assemble, repair, test, and identify the function of brakes, tires, and wheels of the automobile.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
I. Brake		
A. Hydraulic-the science of liquid in motion	A. Explain the basic theory of hydraulics	A. Demonstrate View transparencies Lecture
B. Master cylinder & wheel cylinder	B. Identify master and wheel cylinder	B. Assemble and disassemble both cylinders
C. Brake adjusting 1. manual 2. self	C. Identify and adjust both types of adjustment.	C. Demonstration of brakes View brakes system
D. Parking or emergency brakes.	D. Identify and repair the emergency brakes.	D. Work on brakes Demonstrate with chart Lecture View

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
E. Shoe and Lining Replacement	E. Identify shoes and lining, Example: Primary and Secondary	E. Lecture Read textbook about shoes and lining
F. Remove & Installing brake shoe	F. Choose the solutions to clean brake parts.	F. Observe, step by step on assamble and disassamble lining breake shoes
G. Cleaning and inspecting parts	G. Identify good and bad parts.	G. Demonstration about cleaning brake parts View the parts Read textbook
H. Bleeding and Flushing	H. Describe and identify the various commponent to bleeding and flushing brakes.	H. Observe the diagram of bleeding and flushing brakes
1. Information 2. Bleeding master & 3. Wheel cylinders	Bleeding master and wheel cylinders	Observe by the charts
I. Wheels and Tires	I. Match bias and radials tire	I. View the construction of tires
1. Tires	Differentiate between bias and radial	Lecture and demonstrate
a. Bias and radial tires	Select, identify the various type of tire balance	Read text and demonstrate
2. Tire Balance	R & R weights and bubble balance tire	Study wall chart showing a tire balances
		Work-observe installing & remove tire balance - demonstration, view.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
J. Tire Wear, and Rotating	J. Describe and identify tire wear and rotating	J. Observe the tire wear Lecture and demonstration of rotating tires View the wall chart
K. Wheels 1. Wheel alignment a. Caster b. Camber	K. Identify and follow instruction for wheel alignment Demonstrate the use of equipment for wheel alignment Tell the difference between caster camber	K. Lecture and demonstrate Observe, read instructions Construct the car wheel View caster and camber chart Read, demonstrate all the shims View wall chart and wheel alignment
L. Toe in-Toe out 1. Inner wheel bearing 2. Outer wheel bearing adjusting wheel bearing Greasing	L. Describe and identify difference between to in and to out Define the principle of toe in and toe out Assemble, disassemble, install wheel bearings Describe and adjust wheel bearings Identify the wheel grease Install bearing grease	L. Observe diagram of wheel tow in and tow out Work on wheel Construct experiment of adjusting wheel bearings View, observe wheel grease Work, observe before installing bearing grease.

AUTO MECHANICS III

A. COURSE TITLE: AUTO MECHANICS III

B. COURSE DESCRIPTION

This is an advanced course for those who have taken Auto Mechanics I and Auto Mechanics II. It is designed to broaden the knowledge and skills in the automotive industry in the areas of theory and practical applications.

This course includes orientation, safety, tools and measurements, blueprint readings, welding oxy-acetylene and Arc Welding, body fender and painting, suspensions, power train and air condition.

It provides practical experiences using fabrication materials, supplies, resource materials, testing equipment, and processes which reflect the technology of the automotive industry.

C. GOAL

The goal of Auto Mechanic III is to develop skills which will enable the student for job employment and continuing education in the Automotive technology.

D. OBJECTIVES

1. Develop students' skills for employment.
2. Develop a good working habits and conditions in automotive technology.
3. Develop talents, interests and potentialities for technical pursuits and applied Automotive technology.
4. Develop skills in the propoer use of common Automotive tools, testing equipments and processes.
5. Develop problem-solving and creative abilities involving the materials and process involved in the Automotive technology.

E. COURSE OUTLINE

UNIT I ORIENTATION

A. Course Objective and Course Outline

B. Facility

C. Evaluation

D. Rules and Regulations

E. Work Clothing

UNIT II SAFETY

A. Safety rules for hand tools

1. Screwdriver
    - a. Use screwdrivers that are in good condition for the job
    - b. Use screwdriver that fits properly in the slot with proper width and length.
    - c. Avoid a screwdriver for a turn job other than a screw

2. Cold Chisel
    - a. Use cold chisel without mushroomed end
    - b. Use sharp and correct size of chisel for right job
    - c. Use face mask when working with cold chisel

3. Vises
    - a. Make sure that the vise is securily fastened before use
    - b. Tighten the vise jaws by using downward pressure on the hand
    - c. Hold the object clamped in the vise firmly before loosening it to prevent from falling

4. Pliers
    - a. Do not use the piers for loosening or tightening nuts, bolts, gas lines, etc.
    - b. Cut wire only after both ends of wire are secure or cover.

B. Equipment Safety Fules

1. Bench Grinder
    - a. Use eye shield when operating a grinder
    - b. Keep tools securily adjusted in place
    - c. Do not overload the motor
    - d. Use suitable hand protections before operating the grinder

2. Lifting Devices
    - a. Make sure that peck is squarly on the frames before lifting
    - b. Use all safety devices provided for crane hoist
    - c. Make sure that persons and obstructions are cleared before hoisting.

3. Portable Electric Motor (Electric Grinder & Drill)
    - a. Apply both hands for secure holding before running the motor
    - b. Operate in an open area

c. Plug the electric cord only when the switch is in "off" position
d. Unplugged the cord before engaging the chuck key

UNIT III HAND TOOLS & SPECIAL TOOLS

A. Hand Tools

1. Hammer
    a. Types
    b. Purpose
    c. Care

2. Screwdrivers
    a. Types
    b. Purpose
    c. Care

3. Pliers
    a. Types
    b. Purpose
    c. Care

4. Wrenches
    a. Types
    b. Purpose
    c. Care

5. Files
    a. Types
    b. Purpose
    c. Care

6. Chisels and Punches
    a. Types
    b. Purpose
    c. Care

7. Hacksaw and Blade
    a. Description
    b. Blade types

B. Special Tools

1. Tap and Die
    - a. Types
    - b. Purpose
    - c. Care

2. Impact Wrench
    - a. Purpose
    - b. Care

3. Torque Wrench
    - a. Types
    - b. Purpose
    - c. Care

4. Electric Drill
    - a. Types
    - b. Care

5. Electric Grinder
    - a. Types
    - b. Care

UNIT IV BLUEPRINT READING

A. Fabrication

UNIT V WELDING

A. Welding Orientation

1. Basic metallury

2. Welding joint

3. Job analysis

4. Layout tool

5. Safety

B. Oxy-acetylene Operation

   1. Set-up

   2. Operation

C. Arc Welding

   1. Set-up

   2. Operation

   3. Analyzing welds

UNIT VI BODY FENDER AND PAINTING

A. Introduction

   1. Design and Construction

   2. Auto body Identification

B. Tools and Safety

   1. Basic tools

      a. Hand tools
      b. Power tools

   2. Shop Safety

      a. Flammable liquids
      b. Good housekeeping

C. Methods of Body Repair

   1. Shrinking

      a. Shrinking methods and applications
      b. Stretching

   2. Bumping

      a. Methods and applications

   3. Patching

      a. Method and applications

    - b. Grinding
    - c. Body filter

D. Sanding Compounding

  1. Material use

  2. Types of hand sanding

    - a. Dry sanding
    - b. Wet sanding

E. Surface Preparations

  1. Needed materials

  2. Sanding

  3. Wash

  4. Sealer

F. Auto Painting

  1. Spray gun

    - a. Spray operation
    - b. How to spray paint

UNIT VII POWER TRAIN

A. Clutch Service

B. Transmission

  1. Manual Transmission

  2. Transfer case

  3. Automatic Transmission

C. Propeller Shaft and Joint

D. Differential

E. Axles

UNIT VIII SUSPENSION SYSTEM, FRONT END

A. Malfunction in the wheel alignment

B. Caster

   1. Positive

   2. Negative

C. Camber

   1. Positive

   2. Negative

D. Toe-in and Toe-out

E. Steering Arms

f. Pitman Arm

G. Center Link

H. Idler Arm

I. Tie Rods

J. Steering Gear Box

UNIT IX AUTOMOTIVE AIR CONDITIONING

A. Theory of Operation

   1. Basic compounds

   2. Compressor

   3. Compressor functions

   4. Compressor clutches

   5. Receiver-drier

B. System Controls

   1. Thermostatic Expansion valve

   2. Pilot operated absolute valve

C. Servicing the System

   1. Leak test system

   2. Evacuating the system

   3. Charging the system

D. Diagnosis the System

   1. Diagnosis procedure

Unit: I ORIENTATION AUTO III

Major Objective: Upon completion of this Unit, the student will be able to explain the aims and goals of the course which include facilities and equipment

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Course Objective and Course Outline	1. Explain the aim and goals of the course	1. Lecture
2. Facility	2. Describe and discuss the class facilities and equipments.	2. Tour classroom & equipment areas
3. Evaluation	3. Explain homework requirements, tests, and methods of grading.	3. Lecture on ways for evaluation Ex: textbook, sample test, self-evaluation forms.
4. Rules and Regulations	4. List the rules and regulations	4. Lecture on form pertaining to class rules and regulations.
5. Work Clothing	5. Explain the necessity for work clothing and recognize types of work clothing.	5. Show examples of shop apron and why safety shoes are necessary.

Unit: II SAFETY AUTO III

Major Objective: At the end of the Unit, the student will be able to develop new skills and knowledge in handling the tools properly and safely.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Safety rules for handtools		
a. Screw Driver	1a. Demonstrate the proper way of using a screw driver.	1a. View a film on tools safety
	- Stress the importance of using the right type of tool for the right job.	- Demonstration
	- Explain why a screw driver is strictly for loosening and tightening sloted head screws.	- Lecture
b. Cold Chisel	1b. Demonstrate the proper way to handle a cold chisel	1b. Demonstration
	-Explain the danger of mishandling a cold chisel and the use of mush-roomed end.	-Lecture

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	-List the reasons why a sharp cold chisel is necessary.	
c. Pliers	1c. Specify the importance of sizes of tools and right type of tools for certain type of work.	1c. Lecture
	-Demonstrate the safest way of using a pliers	-Demonstration
2. Equipment Safety Rules		
a. Bench Grinder	1a. List the different types of protective devices used when operating a grinder.	1a. Lecture
	-Demonstrate the proper way of operating the grinder.	-Demonstration
b. Lifting Devices	1b. Demonstrate the proper way of hoisting an object safely	1b. Lecture
	-Explain the importance of clearance before lifting	-Demonstration
c. Portable Electric Drill	1c. List proper use of a drill.	1c. Lecture
	-Explain the danger of improper handling	-Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
d. Vises	1d. List the importance of tool examination before use	1d. Lecture
	-Demonstrate the correct and safe way of operating a vise	-Demonstration
	-List the safety reasons for the vise to clamp objects firmly while working	

Unit: III HAND TOOLS AND SPECIAL TOOLS AUTO III

Major Objective: At the end of this Unit, the students will be able to identify the proper tools for the proper jobs and use them.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Hand Tools		
a. Hammer Ex. plastic, ball pen, and sledge, etc.	1a. Select the correct name of each type of hammer - State the correct use of each hammer - Identify the sizes of each hammer	1a. Lecture & demonstrate - Student view transparencies and list correct names.
b. Screw Drivers Ex. common, cross point, and clutch head	1b. Identify each type of screw driver shown - Explain the proper use of a screw driver	1b. Handouts on screw drivers - Lecture and demonstrate proper use of screw driver

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
c. Pliers	1c. Identify different kinds of pliers	1c. Demonstrate and Lecture
Ex. slip point pliers, water pump pliers, vice crip pliers, long nose pliers, diagonal pliers, and round jaw pliers	- Adjust any pliers by himself - Select when to use each different types of pliers - Choose the proper way of using any pliers.	
d. Wrenches	1d. Identify different kinds of wrenches	1d. Lecture and demonstrate on proper use of wrenches
Ex. open end wrench, box wrench, adjustable wrench, and socket wrench, etc.		- Test
e. Files Types	1e. Recognize between single and double cut files	1e. Lecture and demonstrate
Ex. single & double cut, half round file, flat file, triangle file, and round file	- Explain the proper use and care of files - Identify coarse and smooth files	
f. Chisels and Punches	1f. Explain how to use them properly	1f. Lecture
Ex. cape chisel, diamond chisel, flat chisel, pin punch, and center punch, etc.	- Identify the shape of any chisel - Name the punches and explain their uses	- Demonstrate how to sharp and maintain chisels

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
g. Hack Saw and Blade handle blade	1g. Select blade for different types of work	1g. Lecture and demonstration
2. SPECIAL TOOLS a. Tap & Die b. Impact Wrench c. Torque Wrench d. Electric Drill e. Electric Grinder	2a-e. Identify and operate any of the special tools	2a-e. Lecture and demonstration

Unit: IV Blue Print Reading (Job Order) AUTO III

Major Objective: Upon completion of this Unit, the student will be able to read and understand pictorial view of blue print or (job order) given. The student will be able to construct or do repair work concerning the job order given. This knowledge will be evidenced through demonstration and development of the work done.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Fabrication	1. The student will be able to explain, select, measure, construct and repair according to specification.	1. Lecture - Teacher demonstrate and students participate in lab. - Grade will be given on the quantity of work done.

Unit: V WELDING AUTO III

Major Objective: Upon completion of this Unit, students will have acquired the basic skills and knowledge enabling them to successfully complete welding operations commonly encountered in the Automotive field.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Welding Orientation	1. Define fusion, brazing, steel welding and Arc welding	1. Lecture/discussion
a. Basic metallurgy	1a. Identify, classify and describe characteristics of several different metals with particular emphasis on ferrous metals associated with the automobile.	1a. Demonstration and student experiment Filmstrips - transparencies
b. Welding Joint	1b. Give examples of 5 common joints	1b-c. Bookwork, chart, quiz Transparencies, text-lecture-chart-handout
c. Job Analysis		Lab. work, filmstrips-transparencies
d. Layout Tool	1d. Identify and explain use of 10 layout tools	1d-e. Lecture - quiz
e. Safety	1e. Identify general and personal safety aspects associated with welding.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
2. Oxy-acetylene Operation		
a. Set-up	1a. Identify, explain use of, maintenance & safety rules regarding all tools, materials, equipment and processes associated with oxy-acetylene operation.	1a. Handout - lecture - discussion film and filmstrips - test - chart Ref: "Modern Welding, Chapter 4 and 16
b. Operation	1b. Complete to instructor's satisfaction the following operation: steel (fusion welding), brazing and torch cutting on a wide variety of thickness, shape, and location, particularly to automotive repair. i.e. Overhead exhaust pipe, difficult access mounting brakes.	1b. Demonstrate set-up procedure, regulator and flame adjustment for welding, brazing and cutting operation.
3. Arc Welding	Identify, explain use of and state maintenance procedure. List safety rules associated with all tools, equipment and processes of arc welding.	Handout, lecture. Ref: "Modern Welding", Chapter 6, 8, and 9.
a. Set-up	1a-b. Demonstrate set up procedure, rod selection and machine adjustment for a wide variety of arc welding situation.	1a-b. Lecture using rod and amperage chart, shop demonstration, shop practice View: Filmstrips Ref: "Modern Welding, Chapter 5
b. Operation		

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Analyzing Welds	3. Complete to the instructor's satisfaction a series of welds or selected projects varying on thickness, shape and location. - Analyze and correct problem	3. Lecture on shop practice - View film and filmstrips - Demonstration & lecture - Students lab work

Unit: VI Body Fender and Painting Auto III

Major Objective: Upon the completion of the Unit, the student will be able to develop knowledge, skills and attitude regarding the design, methods, tool and their use in auto body repair and painting. The knowledge and skills will be evidenced by practical application and scoring 85% on the written test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Introduction		
a. Design and Construction.	1a. Describe the knowledge of auto body industries in repair, labor, parts new machines and tools.	1. Read chapter in text and references
b. Identification.	1b. Identify and describe different parts of the auto body and their functions.	1b. Participate in class discussions.
	-Identify and describe how to use them.	-Read chapter in text and reference books.
2. Tools and Safety		
a. Basic Tools.	1a. Identify and describe all types and functions of power tools used	1a. Read chapter in text -Perform demonstrations about the tools.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Shop Safety	1b. Describe all the safety steps used in the shop.	1b. Lecture and handout on steps
Flammable liquids		
Housekeeping	-Describe and emphasize the importance about flammable liquids will cause.	-Read text chapter in textbooks.
	-Describe the rules and steps about housekeeping.	-Participate in class discussions.
		-Demonstrations.
3. Methods of Body Repair	1a. Describe all the methods of shrinking techniques.	1a. Participate in class discussions
a. Shrinking		
Method and applications		-Perform demonstrations
b. Bumping	1b. Identify and describe bumping methods with the proper tools	1b. Participate in class discussions.
c. Patching	1c. Identify and describe patching techniques with the proper tools.	1c. Participate in class discussions -Perform demonstrations -Experiment with the tools in area A, B, & C.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Sanding and Compounding		
a. Material	Describe the importance of sanding.	Read chapter in texts and references.
	Identify and describe types and uses of the sanding tools.	Participate in class discussions
b. Types of Hand Sanding	Identify and describe functions of the material with their uses in the sanding process.	Experiment with the tools
5. Surface Preparation		
a. Material	1a. Identify and describe all types of materials used.	1a. Read text and references. Participate in class discussions.
b. Sanding	1b. Identify and describe sanding techniques and its functions.	1b. Experiment with the tools.
c. Washing	1c. Identify and describe materials, techniques of washing with it's proper procedures.	1c. Perform demonstrations.
d. Sealer	1d. Identify and describe different types of sealer and their uses.	1d. Experiment with the tools.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
6. Auto Painting		
a. Spray Gun	1a. Identify and describe different parts of the spray gun with their functions.	1a. Read text and reference book. - Perform demonstrations.
b. Spray Operations	1b. Describe the proper operation of the gun with its safety uses.	1b. Participate in class discussions.
c. How to Spray Paint	1c. Identify and describe different types of paint. - Perform demonstration on painting processes.	1c. Experiment with tools. - View diagrams.

Unit: VII Power Train Auto III

Major Objective: After the completion of this Unit, the student will be able to overhaul any given transmission. He will be able to do any repair work on any part of the power train. This knowledge will be evidenced by scoring eighty-five percent on the unit test and successfully completed the practical test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Clutch Service	1. Remove and replace the clutch on any given car.	1. Lecture on clutch service
	-Overhaul the clutch.	-Student read Chapter 24 (Clutch Service) in the Auto Service and Repair, by Martin W. Stockel.
	-Check the clutch pressure spring for proper tension.	-Student should have some actual work on the clutch in the lab.
	-Inspect pressure plate and friction disc for wear and warped	-Demonstrate how to work or service the clutch.
	-Overhaul master cylinder on hydraulic type clutch.	-Read Automotive Encyclopedia by William K. Toboldt and Larry Johnson, pages 553-561.
	-Overhaul and replace slave-cylinder. Replace throw-out bearing.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	- Adjust the clutch pedal on both hydraulic and linkage types of clutch following specifications.	
	- Check for flywheel face for warpage.	
	- Checking clutch release finger.	
2. Transmission	Test the clutch if it's working.	
a. Manual Transmission.	1a. Remove and install transmission.	1a. Lecture on standard transmission.
	- Overhaul transmission.	- The student will read Chapter 25, *Manual Transmission of the Auto Service and Repair* by Martin W. Stockel.
	- Inspect the component for wears and damages.	
	- Make all the necessary adjustments, followed the manufacture's specifications.	- In the shop study the three-speed, four-speed, and five-speed transmission.
	- Check transmission oil.	- Student should read Chapter 11 of *Auto Mechanics Fundamentals* by Martin W. Stockel.
	- Change transmission oil.	
	- Test if the transmission shift is working properly.	
	- Adjust gearshift-linkage.	
	- Overhaul overdrive.	
	- Remove and install overdrive, Check oil level of overdrive.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Transfer Case	1b. Remove and install transfer case	1b. Lecture on transfer case services.
	-Overhaul transfer case.	-Reading: Auto Service and Repair page 560-574.
	-Inspect any worn or damage part.	-Practice on assemble and disassemble the transfer case. Lab.
3. Propeller Shaft and Universal Joint Service	3. Remove drive line.	3. Lecture.
	-Remove the unusual joint from the drive line.	-Reading: Auto Service and Repair Chapter 27, by Martin W. Stockel.
	-Check the shaft balance.	-Practice in the shop or lab.
	-Check work on U-joint.	-Demonstration.
	-Replace U-joint.	-Reading: Automotive Encyclopedia pages 617-624, by William K. Tobaldt and Larry Johnson.
	-Install drive shaft.	
	-Grease U-joint.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Differential Service	Disassemble the differential.	Lecture.
	Inspect for worn or damage parts.	Reading: Auto Service and Repair Chapter 28, by Martin W. Stockel.
	Assemble all types of differential.	Lab work actual work on differential
	Make all the necessary adjustment according to manufacture's specifications.	Demonstration on how to assemble and disassemble the differential.
	Installation of the differential.	
	Check and replace the oil.	
5. Axle Service	5. Remove the axle.	5. Lecture.
	-Check for straighteness.	-Read Chapter 28 of Auto Service and Repair.
	-Installation of the axles.	-Demonstration on how to service the axle.
	-Test for end play.	
	-Replace the oil seal.	-Practice in the lab.
6. Automatic Transmission Service	6. Dismount the transmission.	6. Lecture on the servicing of automatic transmission.
	-Make all the adjustments following manufacture's specifications.	-Student will read Chapter 26 of Auto Service and Repair.
	-Adjust the shift linkage.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	-Test the switches.	-Demonstrate on how to overhaul an automatic transmission, how to dismount and install transmission.
	-Install the transmission.	-Shop: practical work
	-Check for oil level.	
	-Change the oil.	
	-Test run the transmission.	

Unit: VIII Suspension System, Auto III

Major Objective: After completion of this Unit, the student will be able to develop knowledge regarding the front wheel suspension, identify parts, trouble-shoot, repair and replacement.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Malfunction in the wheel alignment	1. Trouble-shoot and repair front suspension to meet factory specifications.	1. Read and discuss textbook, Chapter 17, Automotive Mechanics Fundamentals, Martin W. Stockel, The Goodheart Willcox Co., Inc., 1974 ed.
a. Caster Positive Negative	1a. Classify and identify positive and negative caster. - Repair and adjust (if required) positive and negative caster. - Replace any worn parts found.	1a. Show live model "Cutaway" of 6 & 8 cylinder car front suspension and review component parts of the front end suspension system.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Camber Positive Negative	1b. Classify and identify positive and negative camber. Replace any worn parts found.	Discuss, trouble-shoot, and repair, replace common front end suspension problems.
c. Toe-in and Toe-Out	1c. Understand common problems of toe-in and toe-out. Develop understanding which tie rod should be adjusted (if required).	1c-1. Lecture & display any diagrams or charts on front end suspension system. Administered individual test.
d. Steering Arms.	1d. List in writing the five linkage train.	
e. Pitman Arm.	1e. Choose the right tool to disassemble and assemble pitman arm from the gear box.	
f. Center Link.	1f. Identify and locate proper place for center link.	
g. Idler Arm.	1g. Identify and locate proper place for idler arm.	
h. Tie-rods	1h. Identify and locate proper place for tie-rod ends and (replace if required).	
i. Steering Gear Box.	1i. Classify different types of steering boxes. Adjust steering box (if required).	

Unit: VIII Suspension System, Auto III

Major Objective: After completion of this Unit, the student will be able to develop knowledge regarding the front wheel suspension, identify parts, trouble-shoot, repair and replacement.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Malfunction in the wheel alignment	1. Trouble-shoot and repair front suspension to meet factory specifications.	1. Read and discuss textbook, Chapter 17, Automotive Mechanics Fandamentals, Martin W. Stockel, The Goodhear-Willcox Co., Inc., 1974 ed.
a. Caster 1. positive 2. negative	1a. Classify and identify positive and negative caster. - Repair and adjust (if required) positive and negative caster. - Replace any worn parts found.	1a. Show live model "Cutaway" of 6 & 8 sylinder car front suspension and review component parts of the front end suspension system.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Camber 1. Positive 2. Negative	b. Classify and identify positive and negative camber. _ Replace any worn parts found.	_ ·Discuss, trouble-shoot, and repair, replace common front end suspension problems. - dLecture and demonstration
c. Toe-in and Toe-Out	c.1 Understand common problems of toe-in and toe-out. _ Develop understanding which tie rod should be adjusted (if required).	- Display any diagrams or charts on front end suspension system. _ Administered individual test.
d. Steering Arms.	d.1 List in writing the five linkage train.	
e. Pitman Arm.	e. Choose the right tool to disassemble and assemble pitman arm from the gear box.	
f. Center Link.	f. Identify and locate proper place for center link.	
g. Idler Arm.	g.1 Identify and locate proper place for idler arm.	
h. Tie-rods	h. Identify and locate proper place for tie-rod ends and (replace if required).	
i. Steering Gear Box.	i. Classify different types of steering boxes. i.1 Adjust steering box (if required).	

Unit: IX Automotive Air Conditioning Auto III

Major Objective: After the completion of this Unit, the student will be able to explain and demonstrate the basic theory, operations, services and diagnoses of the system.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Theory of Operation.	1. Describe the operation of the Automotive Air Conditioning.	1. Lecture and Read the Text.
a. Basic Components.	1a. Identify and describe the five basic components of air conditioners.	1a. Lecture and read text manual.
b. Compressors.	1b. Identify and name the parts of compressors.	1b. Lecture and read text manual.
c. Compressor Functions.	1c. Explain the functions of compressor.	1c. Lecture and read the text books.
d. Compressor Clutches	1d. Identify and describe types of magnetic compressor clutches.	1d. Lecture and read the text books.
e. Receiver-Drier	1e. Identify and explain the functions of the Receiver-Drier.	1e. Lecture and discussions on functions

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
2. System Control		
a. Thermostatic Expansion Valve.	2a. Identify and explain the main functions of the thermostatic expansion valve.	2a. Lecture and read text books.
b. Pilot Operated Absolute Valve.	2b. Name the parts and describe the operation of the pilot operated absolute valve.	2b. Lecture and read text books.
3. Servicing the System	3. Describe the services of Automotive Air Conditioning.	3. Lecture and read text books and references.
a. Leak Test System	3a. Describe some of the possible causes of the refrigerant leakage.	3a. Lecture and read text books.
b. Evacuating the System	3b. Use the vacuum pump to evacuate the air and moisture in the system before new refrigerant is installed.	3b. Lecture and perform demonstrations.
c. Charging of the System	3c. Explain and follow the procedures of charging the system.	3c. Lecture and perform demonstrations.
4. Diagnosis of the System	4. Diagnose the system when it leaks of cooling and insufficient cooling.	4. Lecture and perform demonstrations.
a. Diagnosis Procedure	4a. Follow the diagnostic procedure to determine the conditions of the system.	

SMALL ENGINES

A. COURSE TITLE: SMALL ENGINES

B. COURSE DESCRIPTION

The course is designed to develop the basic knowledge in construction, function, selection, and care for small engine. The student acquires skills in scientific and mechanical principles in the various components of small engine through servicing, repairing, diagnosing, adjustments, and reading specifications.

C. GOAL

The goals of this course is to develop the basic understanding of the relationship of parts at work in converting mechanical power into useful work. Through this concept it will develop skilled people in servicing, repairing and overhauling of the small engines. The students will be prepared to entry level on the job market or to pursue a higher level of learning in small engines.

D. OBJECTIVES

1. Develop the basic knowledge and skill in which apply to entry level in the field of Small Engines.
2. Develop skill and knowledge in relating mechanical power to producing useful products.
3. Develop the knowledge and skill of safe working habits in the Small Engine trades.
4. Develop basic skills in proper use of common Small Engine tools, equipment testers, and measurements.
5. Develop an insight into the conduct required of a worker in Small Engine trades.
6. Acquire experience in various production techniques as used by the Small Engine industry.
7. Develop students motivation in pursuing his career in the area of Small Engine trades.

E. COURSE OUTLINE

UNIT I ORIENTATION

A. Definition of Small Engine

B. Course requirements

C. Career Opportunities (SGE)

D. Facilities

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UNIT I SAFETY

A. Shop safety housekeeping

B. Equipment tool safety

C. Fire and ventilation

D. Emergency first aid procedure

UNIT III TOOLS - MEASUREMENT - FASTENERS

A. Handtools

B. Specialized Tools

1. Small Engine
2. Outboard

C. Measurement

1. Metric
2. Standard

UNIT IV MANUAL READING

A. Orientation to mechanic manual (see content outline)

B. Utilization of mechanic manuals

1. Parts manuals

UNIT V MECHANICAL PRINCIPAL PARTS & ENGINE OVERHAUL

A. Theory of operation - 2 cycle - 4-cycle

B. Two and four cycle basic engine parts

C. Engine disassemble - 2-cycle and 4-cycle engine.

D. Cylinder - 2-4 cycle engine

D. Piston & connecting rod assembly two and four cycle engine

F. Crankshaft - two and four cycle

G. Valve train assembly - two and four cycle engine

H. Reassemble - two and four cycle engine

UNIT VI FUEL SYSTEM

A. Fuel tank

B. Fuel line

C. Fuel filter

D. Fuel pump

E. Air cleaner

F. Carburetors

G. Gasoline

H. Fuel System

UNIT VII IGNITION SYSTEM

A. Ignition design and theory of operation

B. Spark plug

C. Ig-coil

D. Condenser

E. Braker points

F. Magneto

G. Ignition advance mechanisms

H. Testing ignition system

UNIT VIII COOLING SYSTEM

A. Purpose of cooling system

B. Types of cooling system (2-4 cycle)

C. Heat transfer

D. Cooling defects

E. Cooling system's components and their functions (2 cycle and 4 cycle)

F. Services, repair, and maintenance

UNIT IX LUBRICATION SYSTEM

A. Purpose of the lubrication system

B. Types of lubrication system

C. Grade and types of oil use

D. Rating and classification of oil

E. Selection of oil

F. Lubrication system components and their purposes. Ex. oil filter, oil pump, etc.

UNIT X LOWER UNIT

A. Parts

B. Functions

C. Diagnosing the problem of the lower unit

UNIT XI TROUBLESHOOTING

A. No fuel delivery

B. Carburetor flooding

C. No spark at spark plug

D. Engine has no power

E. Engine misfire

F. Too much smoke

G. Excessive oil consumption

H. Engine will not start

I. Engine will not turn

J. Engine overheat

K. Poor performance on boat

Unit: I ORIENTATION SMALL ENGINE I

Major Objective: Upon completion of this Unit, the students should have acquired the basic understanding of Small Engine mechanic's requirement, career opportunities, facilities and safety rules and procedures.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Definition of Small Engine Mechanics	1. Define what is Small Engine Mechanics	1. Lecture
2. Course Requirements	2. List and define the requirements for this course	2. Discussion/handouts
3. Career Opportunities (S.G.E.)	3. List & discuss all the career opportunities under (S.G.E.)	3. Lecture, discussion and notes handout
4. Facilities	4. Locate, identify and demonstrate the usage of all available shop facilities in (S.G.E.)	4. Tour the facilities, lecture and demonstration

Unit: II SAFETY SMALL ENGINE I

Major Objective: Develop knowledge and skills by identifying, describing, and demonstrating of safety practices in the shop and handling of tools and equipment. This knowledge will be evidenced by scoring 100% on a written test given by the instructor.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Shop Safety Housekeeping	1. Describe & demonstrate the basic safety in the shop	1. Perform demonstrations
	1. Describe and demonstrate to the instructor's satisfaction how to keep the shop clean, and in order	1. Read textbooks
1.a Basic Safety	1.a Perform & describe shop activities in accordance with accepted safety standard.	1.a Read text and manual references
Equipment & Tool Safety		
a Rotating Machinery	2.a Describe & perform correct ways of operating rotating machinery	2.a Perform demonstrations
b Goggles	2.b Perform & describe correct ways of using safety goggles	2.b Participate in class discussions

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SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Fire Protection		
a. Closed containers	3.a Describe the proper way of keeping the combustible materials in closed containers.	3.a Participation in class discussions
b. Fire Extinguisher	3.b Describe & identify different parts of extinguisher & how to use it.	3.b Read text and manual references
4. Ventilation	4. Describe the differences between a good ventilation and a bad ventilation.	4.a Perform experiment
		4.b Participate in class discussion
5. Emergency First Aid Procedure	5.1 Describe the first aid procedures in handling first aid kit.	5.1 Perform demonstrations
	5.2 Describe and demonstrate how to treat a minor injury in the shop.	5.2 Participate in class discussions

Unit: III Tools-Measurement-Fasteners SMALL ENGINE I

Major Objective: Upon the completion of this Unit, students will have a relatively thorough understanding of tools and fasteners associated particularly with the Small Engine industry. In addition, they will increase their skills in measurement to the highest level required in the mechanics field.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Hand Tools	1. Identify, explain advantages and disadvantages, specify maintenance and safety aspects, display proper selection and use of all hand tools required in small engine mechanics repair. (See Outline)	1. Review tools covered in Pre-Voc. course & place emphasis on new information & tools 1. Pretest on Pre-Voc. course material 1. Shop Demonstration 1. R & R various fasteners on shop aids 1. Post-test, 75% requirement for working in shop. (Otherwise, remain toolroom attendant). 1. Lecture, outline, Handout, for student note taking, transparencies, films.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
2. Specialized Tools for Small Engine and Outboard	2. Identify, explain advantages and disadvantages, specify maintenance & safety aspects, display proper selection & use of all specialized tools required in small engine mechanics repair.	2. Ref: "Auto Service & Repair", Chapter 1. "Automotive Mechanics", Chapter 1 "Comprehensive Small Engine Repair Student Materials", Unit 3. 2. Lecture, outline handout for student note taking, transparencies, films, test. 2. Shop demonstrations 2. Students R&R components requiring special tools 2. Ref: Johnson O.B. Manuals Briggs & Stratton Manuals Johnson Special tools kits
3. Measurement	3. Identify, explain advantages and disadvantages, specify maintenance & safety aspects, dispaly proper selection & use of all measurement tools from Pre-Voc course & in addition: Inside & outside Micrometers and calipers, split ball gauge, plastic gauge, dial test indicators.	3. Review basic measurement & tools from Pre-Voc course 3. Lecture, outlined handout for student note taking, transparencies, film, test. Ref: Specification charts & manuals "Auto Service & Repair", Chapter 2. "Automotive Mechanics", Chapter 8.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	3. Measure static engine parts to an accuracy of .001 & .01mm	3. "Comprehensive Small Engine Repair Student Materials", Unit 4.
	3. Measure runout, endplay, backlash, freepaly to an accuracy of .001 & .01mm.	
4. Fasteners & Retaining Devices	4. Identify, explain advantages & disadvantages, dispaly proper selection and use of all fastening & Retaining Devices required in Small Engine Mechanic Repair. (See Outline)	4. Review fasteners covered in Pre-Voc course & place emphasis on new fasteners and retainers common to the small engine.
		4. Pre-test on Pre-Voc course material
5. Threading Processes and Repair	5. Outline contingency sequence & perform all thread repair procedures, particularly those associated with repair of aluminum components, i.e. (Helicoil, steel insert, etc.)	5. Review "threading section" in Pre-Voc with quiz
		5. Demonstrations and student shop work

Unit: IV Manual Reading SMALL ENGINE I

Major Objective: Upon completion of this Unit, the students will be able to understand the uses of series manual associated with Small Engine repair.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Orientation to Mechanic Manual (See content outline)	1. Describe & explain general format of parts, repair, specification and flatrate manuals.	1. Lecture/discussion, transparencies, handouts, examination of various small engine manuals.
	1. Locate required information on specific jobs from a broad selection of various mechnics manuals	
	1. Define a series of mechanics related words found in the text of various mechanics manuals	
2. Utilization of Mechanics Manuals	2. Perform comprehensive repair procedures using repair & specification manuals	2. Demonstration & student shop activities
a. Parts Manuals	2.a Identify various parts by name and number as given in parts manuals	2.a Lecture/discussion, transparencies, demonstration & student shop activities, field tirp to local parts department and/or resource person

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	2.c Identify flat rate allowances for specific jobs.	2.a Lecture/discussion, transparencies, demonstration and student shop activities, field trip to local repair shop.
	2.d Explain the concept of "Flat-Rate" and demonstrate efficient work habits in live jobs	

Unit: V Mechanical Principal, Parts & Engine Overhaul SMALL ENGINE I

Major Objective: At the completion of this Unit, the student will have acquired the basic understanding on the theory of operation on two & four cycle engines. Also, they will gain a good knowledge on how to overhaul two & four stroke cycle engines.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Theory of operation - Two & Four Cycle Engines	1. Describe the theory of operation on both	1. Discussion on principal of operation Demonstration in intake, compression, power & exhaust
2. Two & Four Cycle basic Engine Parts	2. Identify and explain the basic parts of two and four cycle engines and their functions	2. Parts handouts & discussion on the parts
3. Engine Disassemble-Two & Four Cycle Engines	3. Demonstrate the correct steps involved in disassembling two & four cycle engines	3. Handouts on steps & demonstrate each steps
4. Cylinder-Two & Four Cycle	4. Demonstrate and describe the procedure in inspect & service of the cylinder on two & four cycle engines	4. Discussions & demonstration on how to inspect & service the cylinder

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
5. Piston & connecting rod assembly (Two & Four Cycle Engines)	5. Identify & describe the parts of piston & connecting rod assembly and how to inspect & service them.	5. Parts handouts, lecture using transparencies on parts and discussion
6. Crankshaft-Two & Four Cycle	6. Identify each part of the crankshaft and describe the procedures in inspecting and servicing the parts	6. Discussion on various crankshaft, designs, & demonstration on how to service and inspect the crankshaft.
7. Valve train assembly (Two & Four Cycle)	7. Demonstrate the ability to inspect and service the valve train assembly	7. Discussions & demonstration on how to reconstruct the valve train
8. Reassemble - Two & Four Cycle Engines	8. Demonstrate & describe the steps involved in reassemble Two & Four stroke cycle engines	8. Handouts & lectures on the steps involved in reassembling the two types of engines.

Unit: VI FUEL SYSTEM Small Engine I

Major Objective: After completion of this unit, the student will be able to identify each of the components of the Fuel System. The student will be able to replace, remove, and service all the Fuel System components. This knowledge will be evidenced through demonstration and by scoring 90% on the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Fuel Tank	1. Identify different types of fuel tank Locate the fuel tank Service the fuel tank	1. Lecture on types and purposes of fuel tank
2. Fuel Line	2. Repair fuel line Identify different types of fuel line	2. Lecture on fuel line Demonstrate how to repair fuel line
3. Fuel Filter	3. State the purpose of the fuel filter Name the different types of fuel filter Replace and service fuel filter	2. Lecture on the fuel filter Demonstration on how to service fuel filter

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Fuel Pump	4. Explain the operation of fuel pump	4. Lecture on operation, types, and application of fuel pump
	4.1 Identify the different types of pump and explain the application of each type.	4.1 Show how to service fuel pump
	4.2 Explain the difference between the fuel pumps use on two cycle and four cycle engine.	4.2 Practice overhaul and service fuel pump
5. Air Cleaner	5. Explain the purpose of air cleaner.	5. Lecture on air cleaner operation
	Identify the three types of air cleaners used on four cycle.	Demonstration on how to service the three types of air cleaners
	Service the three types of air cleaners	Practice how to service air cleaners on a running engine.
6. Carburetors	6. Explain the operation of carburetor.	6. Lecture on carburetor
	Identify the carburetor's components.	Show the two general types of carburetor
	Explain the functions of each component of carburetor.	Demonstration on how to overhaul carburetor.
	Service or repair any given carburetor.	Practice overhauling carburetor.
	Make all the necessary adjustments when overhaul carburetor, follow manufacturer's specifications.	Demonstration on how to make all necessary adjustment on the carburetor.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	6. Make final adjustment on the carburetor when the engine is running.	6. Draw a carburetor and name the parts.
7. Gasoline	7. Explain why gasoline is important in the engine operation. Explain why only certain types of gasoline are used in a small engine.	7. Lecture on purposes and application of gasoline.
8. Fuel System	8. Explain the purpose of fuel system. Identify the different types of fuel system. Explain why oil and gasoline are mixed in two cycle engine but not in four cycle engine. Compare the fuel system of two cycle engine with fuel system of four cycle and list their differences.	8. Lecture on different types of fuel system

Unit: VII Ignition System Small Engine I

Major Objective: After completion of this unit, the student will be able to explain the operation of the components and repair the various parts of the ignition system. This knowledge will be proven through demonstration and by scoring eighty-five percent on the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
1. Ignition Design & Theory Operation	1. Explain the operation and list all the components of the Ignition System.	1. Lecture on Ignition System and give handout sheets.
2. The Spark Plugs Design and Construction	2. Explain the construction of the spark plugs.	2. Spark plug design & construction Text, Unit 7.
	Explain the operation & design of various spark plugs.	Show different types of spark plugs.
3. The Coil	3. Discuss the operation & construction of ignition coil. Explain the difference between battery & magneto ignition coil.	3. Show to the students the two types of coil.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
4. Condenser	4. Disassemble a condenser to explain its construction.	4. Lecture/discussion on condenser
5. Braker Point	5. Define and discuss the purpose of opening and closing of the braker points.	5. Lecture Read Chapter 5 on Small Engine
6. The Magneto	6. Explain the two types of magneto ignition system.	6. Handout information sheets Read Small Gasoline Engine, Chapter 5, p. 8 Listen to lecture on ignition system.
7. Ignition Advance Mechanisms	7. Discuss the construction & operation of the mechanical vacuum advance mechanisms.	7. Demonstration of vacuum advance mechanisms.
8. Testing	8. Test the coil, condenser, and power pack.	8. Demonstration
	Check ignition timing and flywheel magnet.	Participation & laboratory activities.

Unit: VIII Cooling System Small Engine I

Major Objective: At the end of this unit, the students will gain a fundamental understanding on the purpose of the Cooling System, components, & functions. The student will be able to service and repair any component of Cooling System. The student should score 90% on the unit test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
1. Purpose of Cooling System	1. Describe the purpose of Cooling System	1. Lectures on the function of Cooling System.
2. Types of Cooling System (2 & 4 Cycle)	2. Identify the types of Cooling Systems and describe how each one works (2-cycle and 4-cycle)	2. List the types on board and lecture on each one.
3. Heat Transfer	3. Define and demonstrate how heat transfer works.	3. Lecture and demonstrate on heat transfer and poor heat conductors.
4. Cooling Defects	4. Explain and list at least 10 cooling system defects.	4. Handout on a list of defects and lecture.
5. Cooling System's Components and their Functions (2-cycle and 4-cycle)	5. List and define the functions for the two types of engine's cooling system.	5. Handouts, discussion, and lecture on parts and functions. (Show samples: 2-4 cycle engine)

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
6. Service, Repair, and Maintenance	6. Describe & demonstrate the proper ways for service, repair and maintaining the cooling system (on 2 & 4 cycle engine)	6. Demonstrate how to service, repair, and maintenance.

Unit: IX Lubrication System SMALL ENGINE I

Major Objective: Upon completion of this Unit, the students will acquire the basic understanding of the lubrication system: purposes, types, components and their fuctions. Also, they will know how to identify different grades and types of oil: selection, rating, classification, and additives.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Purposes of the Lubrication System	1. Describe the purpose of lubrication system	1. Discussion on purpose
2. Types of lubrication systems (2 & 4 cycle) Ex. pressure-splash.	2. Identify and explain the types of lubrication system use on 2 & 4 cycle	2. Handouts, transparencies on different types and discussion
3. Grades & Types of Oil use	3. Distinguish between different grades and types of oil and explain their usages	3. Handouts on grades & types - Discussion
4. Ratings & Classification of Oil	4. Describe & identify different ratings and classifications	4. Demonstration on ratings and classification - discussion

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
6. Selection of Two Cycle Oil and use	6. Select the right kind of oil used on a two cycle engine and use according to manufacturer's specifications	6. Demonstrate how to select oil and have student try on their own - Lecture
7. Lubrication System components and their purposes Ex. Oil filter, oil pump	7. Identify and describe each component of the lubrication system (two-four cycle)	7. Handouts on components and parts Lecture

Unit: X LOWER UNIT Small Engine I

Major Objective: At the end of the unit, the student will be able to develop new skill and knowledge in locating, diagnosing and servicing of the Lower Unit. This knowledge will be evidenced by scoring 95% on the examination.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. Gearcase	1. Describe the components of the gearcase.	1. Lecture
a. Forward gear b. Reverse gear c. Pinion gear d. Propeller shaft e. Clutch dog f. Bearing head	1.1 Demonstrate how each one works.	1.1 Demonstration
2. Steering Components	2. Identify each parts of the steering correctly.	2. Lecture
a. Steering handle b. Steering brackets c. Pilot shaft d. Swivel bracket	2.1 Specify the locations of each part and the function of each.	2.1 Demonstration 2.2 Transparencies

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
3. Exhaust Housing Components a. Tune exhaust b. Exhaust relief c. Exhaust outlet	3. Describe and identify the components of the exhaust system. Show the flow of exhaust in the engine.	3. Lecture Transparencies Demonstration
4. Drivershaft	4. Describe the functions and location of a drivershaft.	4. Lecture Transparencies Demonstration
5. Shifting Components a. Shift lever shaft b. Shift rod c. Connector d. Shifting lever e. Cradle f. Yoke g. Clutch dog h. Detent balls i. Spring	5. State the purpose of the shifting system and give functions of the components. Identify each part and location on the lower unit.	5. Lecture Transparencies Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
6. Water Pump Components	6. Give the purpose of the water pump.	6. Lecture
a. Water tube b. Impeller key	Show the operation of the water pump in regards with the lower unit.	Transparencies
c. Impeller d. Grommet e. Impeller housing f. Impeller plate	Identify all components and their locations on the lower unit.	Demonstration
7. Propeller Components	7. Show the parts and operation of the propeller.	7. Lecture
a. Thrust bushing b. Propeller c. Spacer	Show the operation of the water pump in regards with the lower unit.	Transparencies
d. Cotter pin e. Propeller nut f. Propeller shaft	Identify all components and their locations on the lower unit.	
8. Components that fasten engine to the boat	8. Demonstrate the importance of clamps bolts, and the stern brackets.	8. Lecture
	Locate the parts on the engine.	Demonstration
9. Throttle Components	9. Show the throttle parts.	9. Lecture
a. Throttle shaft b. Throttle gripe c. Throttle gears	List the importance of each part in regard to the engine.	Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
10. Functions of Lower Unit	10. Explain the importance of the engine to be fastened securely.	10. Lecture
a. Enable the engine to reach into the water to propel the boat and supply coolant.	Give and explain the functions of the lower unit.	Demonstration
b. Provide a device on the engine to fasten to the boat transom securily.	Demonstrate the lower unit and how it is used for steering.	

Unit: XI Troubleshooting Small Engine I

Major Objective: After the completion of this unit, the student will be able to troubleshoot engine problems. He will be able to correct the problem after finding the possible causes. This knowledge will be evidenced by scoring 100% on the practical test and 90% on the written test of this unit.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
1. No Fuel Delivery	1. Check gasoline tank. Adjust carburetor float, too low. Check needle valve, stuck close. Check gas line for clogging. Check fuel pump for inoperating. Check for clogged fuel filter.	1. Lecture on fuel system Practice troubleshoot on running engine.
2. Carburetor Flooding	2. Check needle valve, stuck open. Adjust float, too high	2. Lecture on carburetor. Practice on a carburetor of running engine.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Clean dirt at the inlet needle valve	
	Check choke, may stuck close	
	Clean dirty air filter	
	Replace float	
3. No spark at the spark-plug	3. Check flywheel, may be broken	3. Lecture on troubleshooting of ignition system.
	Check the ground wire, may be grounded.	
	Check for broken spark-plug wire	Demonstrate how to check the possible cause of no spark at spark-plug.
	Check and replace condenser	
	Check the coil ground, loose or broken circuit.	
	Check spark-plug, not working.	
	Check conductor points, stuck open or close.	
	Adjust coil, may set too far from the rotating magnet.	
4. Engine has no power	4. Adjust spark-plug gaps	4. Lecture
	Take compression test	Demonstration on how to take compression test.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Determine the cause of low compression reading.	Practice in the shop.
	Adjust the mixture screw on the carburetor.	Lecture & demonstrate on how to determine the causes of low compression.
5. Engine misfire	5. Adjust the spark-plug gap	5. Lecture on engine troubleshooting
	Replace spark-plug, not working good or wrong spark-plug.	On an engine, demonstrate how to check for possible causes of engine misfire.
	Correct carburetor adjustment, fuel may be too lean or too rich.	
	Correct ignition timing.	
	Adjust conductor points gap	
6. Too much smoke coming out from exhaust pipe	6. Adjust carburetor, rich mixture.	
	Check oil level, too much oil in the crank case.	6. Demonstration on checking the possible causes of too much smoke coming out from the exhaust pipe.
	Take compression test to determine whether oil is leaking into combustion chamber.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
7. Excessive oil consumption (assuming engine is running good)	7. Check for cracked crankcase.	7. Lecture on troubleshooting of lubrication system.
	Check for crankshaft straightness.	
	Check for crankshaft oil seal for worn condition.	
	Check for loose crankcase colts, it must be torqued down).	Show the places to be checked for oil leak.
8. Engine will not start	8. Check fuel system.	8. Lecture on troubleshooting
	Check ignition system.	Demonstration on how to check ignition and fuel system if they are functioning properly.
	Check compression (reading should be within the manufacturer's specifications.	
9. Engine will not turn	9. Check for frozen piston.	9. Lecture
	Check for broken connecting rods and replace them.	
10. Engine overheat	10. Dirt on the cooling vanes so student should be able to clean them (air cool)	10. Lecture on troubleshooting of cooling system.
	Check for oil consumption.	Demonstration on how to check the possible causes of engine overheating.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	Check ignition timing.	
	Check for water pump, may not work (liquid cool).	Practical work in the shop on material covered during lecture.
	On liquid cooling, check for stock close thermostat, replace it if necessary.	
	Check for clogged water jacket.	
	Follow the manufacturer's specifications, mix the oil with the gasoline for two-cycle engine.	
11. Poor performance on boat	11. State the values of propeller, and the proper selection of propeller with the understanding of propeller pitch and diameter.	11. Lecture
a. Motor adjustment Incorrect propeller Incorrect tilt angle Remote control incorrectly adjusted.	Recognize the use of tilt angle and remote control adjustment and the effects they could do to the motor,	Demonstration

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
b. Cavitation Protruding hull attachment Keel too long Bent propeller Transom too high	Demonstrate the cause of cavitation and the proper remedies for cavitation.	Lecture Participation: a. Service a bent propeller b. Cut transom to appropriate size c. Correct hull and keel
c. Boat Improper load distribution Marine growth on bottom Added weight (water absorption)	Show the proper way a boat should be for best performance of the engine.	Lecture Demonstration

APPENDIX A

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Example Vocabulary List - From Basic Handtools Unit (To be kept in student Notebook)

These vocabulary lists may be incorporated with each new unit or on a weekly basis.

References: Dictionary, Thesaurus, Automotive Mechanics by Crouse and Auto Service and Repair, by Stockel

Method of Instruction: Lecture with blackboard or overhead projector - student note taking. Discussions, questions/answers. Follow-up quiz on each set of words. Time: 15 words x 3 min. each = 45 min.

1. Retaining
2. Graduation
3. Restricted
4. Advantage
5. Disadvantage
6. Adjustable
7. Combination
8. Application
9. Irregular
10. Adapter
11. Extension
12. Flexible
13. Swivel
14. Diagonal
15. Joint

POWER MECHANIC

Outline Handout for Student Notes

Fasteners

1. Sheet metal screws or self tapping screws
    - a. Head types: flat, oval, counter sink, round
2. Machine screws:
    - a. Head types: cap or hex, flat, oval, round
    - b. Drive types: Allen, phillips, slotted, spline, hex
3. Set screws
    - a. Types: flat, cone, cup, oval
4. Bolts
    - a. Heads: square and hex
5. Studs
6. Nuts
    - a. hex or plain, square
    - b. locking: castle, slotted
    - c. self locking: soft collar, interference, palnut
    - d. Special application: wingnut, speednut, acorn
7. Washers
    - a. locking: external, internal, spring, split
    - b. Flat: regular, fender
8. Special application locking devices
    - a. lock plates
    - b. safety wire
    - c. cotter pins

9. Special application retaining devices
    - a. splines
    - b. pins
    - c. keys
    - d. snap rings-internal and external

B. Pliers

1. needle nose or long nose
2. chain nose
3. slip joint
4. vise grip
5. cutting
6. channel lock
7. electrician
8. snap ring
9. special application types

C. Screwdrivers

1. flat blade or standard
2. phillips
3. Reed & Prince
4. Variations

    1. stubby
    2. offset
    3. retaining

D. Cutting Tools

1. hack saw

    a. blade type

2. jabsaw
3. chisels
4. files

    a. shape
    b. cutting depth
    c. cutting style

5. drill bits
6. thread taps
7. thread dies
8. metal shears

E. Impact Tools

1. Hammers

    a. ball pen
    b. plastic
    c. rubber mallet
    d. brass or lead tip
    e. special purpose

2. Punches
    a. starting
    b. aligning
    c. drift on pin
    d. center

F. Cleaning Tools
    1. carbon brush
    2. solvent brush
    3. wire brush
    4. gasket scraper
    5. flexible scraper

G. Measuring Tools
    1. steel rule
    2. divider & callipers
    3. garages
        a. flat or leaf type
        b. wire type

H. Pullers
    1. wheel
    2. battery terminal
    3. variable

J. Specialized Tools

III. Equipment
    A. Drill (hand held)
    B. Drill press
    C. Solvent base
    D. Compressor (air)
    E. Power Hammer

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POWER MECHANICS

TOOLS HANDOUTS:

I. System of Measurement

  A. Metric
  B. American Standard

II. Basic Hand tools:

  A. Wrenches

    1. Open-end
    2. Box-end
    3. Combination
    4. Adjustable

      a. crescent
      b. pipe

    5. Allen
    6. Socket driving handles

      a. impact driver
      b. breaker bar
      c. ratchet
      d. spinner
      e. speeder
      f. torque wrench

    7. Socket handle attachements

      a. adapters
      b. extensions
      c. universal joint
      d. sockets

        1. 6 points
        2. 8 points
        3. 12 points
        4. deep
        5. swivel
        6. special application drivers

    8. Special application types

Example Problems For "Energy Orientation" Unit.

> These problems are designed to incorporate mathematics into the standard power mechanics curriculum in order to demonstrate to the students the value and interrelationship of Academic Subjects with vocational development coursework. Ultimately, this will promote a new and refreshing attitude of interest for those students unable to recognize practical application of the academic skills from previous vocational curricula.

Method of Instruction: Individual Instructor: Classwork and/or homework, to follow lecture in "Energy Calculations and Interrelationships" including conversion of units.

1. Given: weight 120 pounds
   distance 20 feet

   Find: Work

2. Given: Force 250 Kilogram
   distance 12 meters

   Find: Work

3. Given: Weight 165 pounds
   distance 20 feet
   time 45 seconds

   Find: 1) mechanical power
   2) horsepower

4. Given: work 180 meter-kilograms
   time 10 minutes

   Find: 1) mechanical power
   2) horsepower

5. Given: Force 40 pounds
   Radius 2 feet

   Find: Torque

6. Given: Force = 28 kilograms
Radius = 12 centimeters

Find: Torque

7. Given: Force = 250 lbs
Area = 50 sq. in.

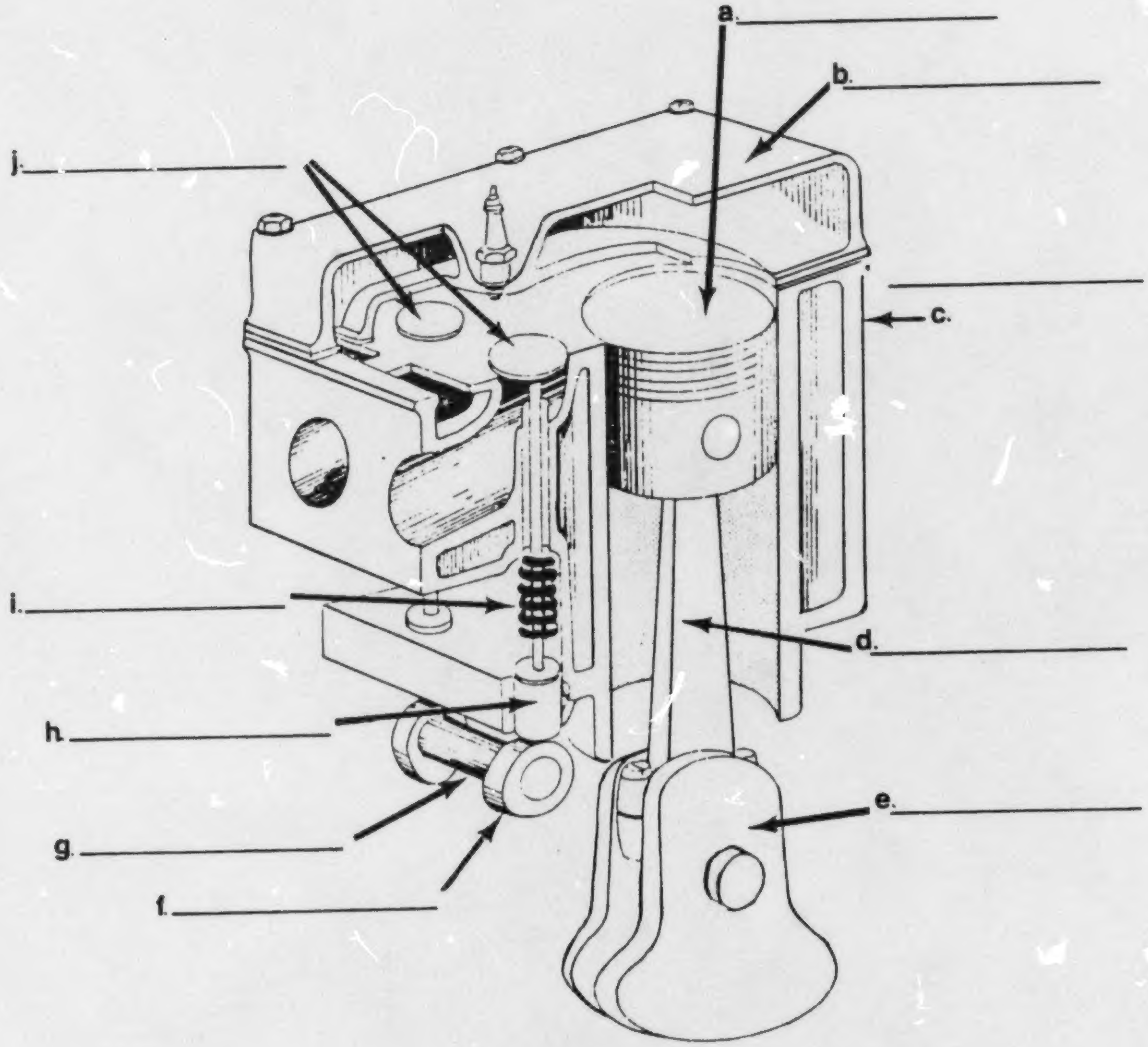
Find : Pressure

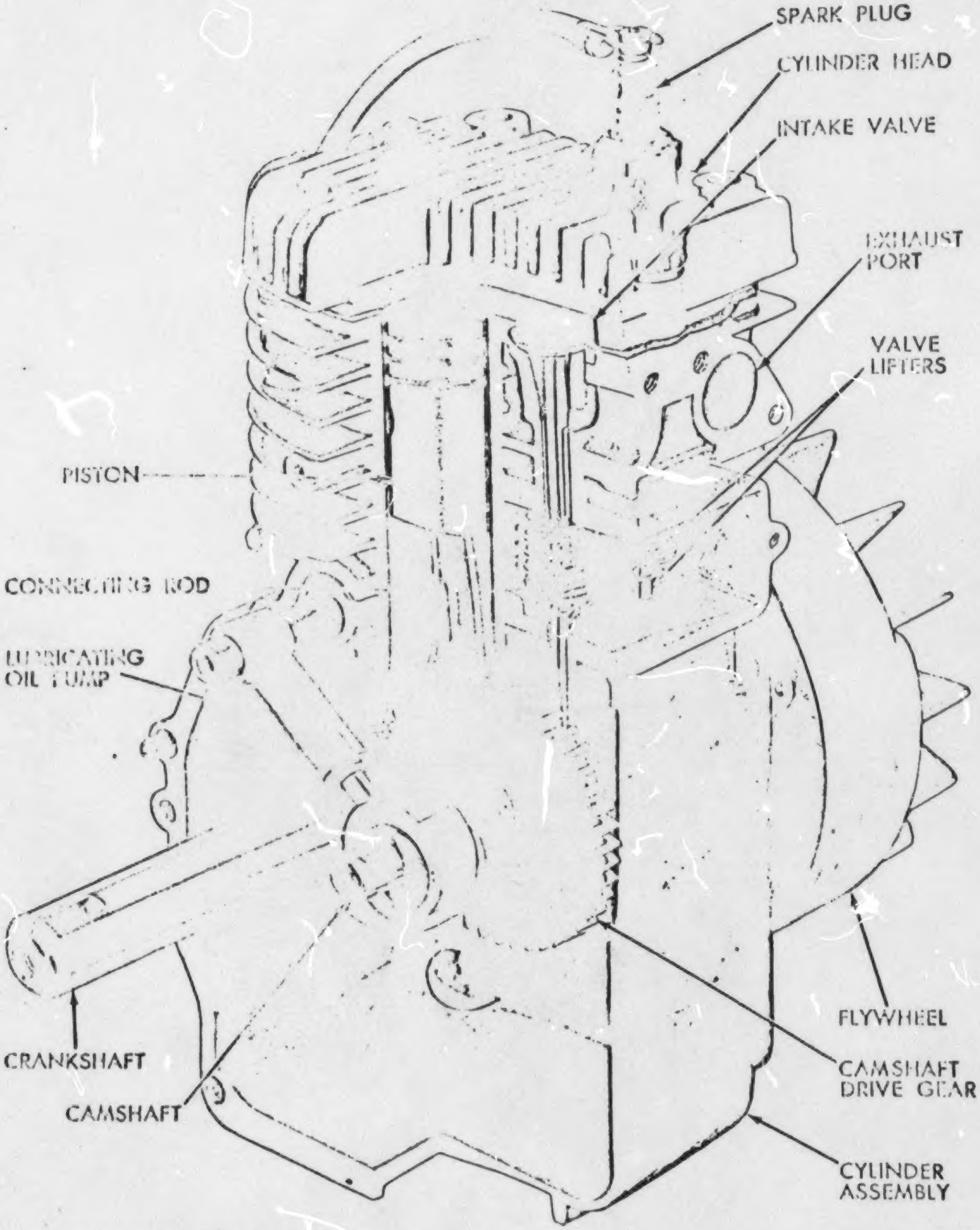
8. Given: Force = 80 kilograms
Area = 10 centimeter

Find : Pressure

Example Test

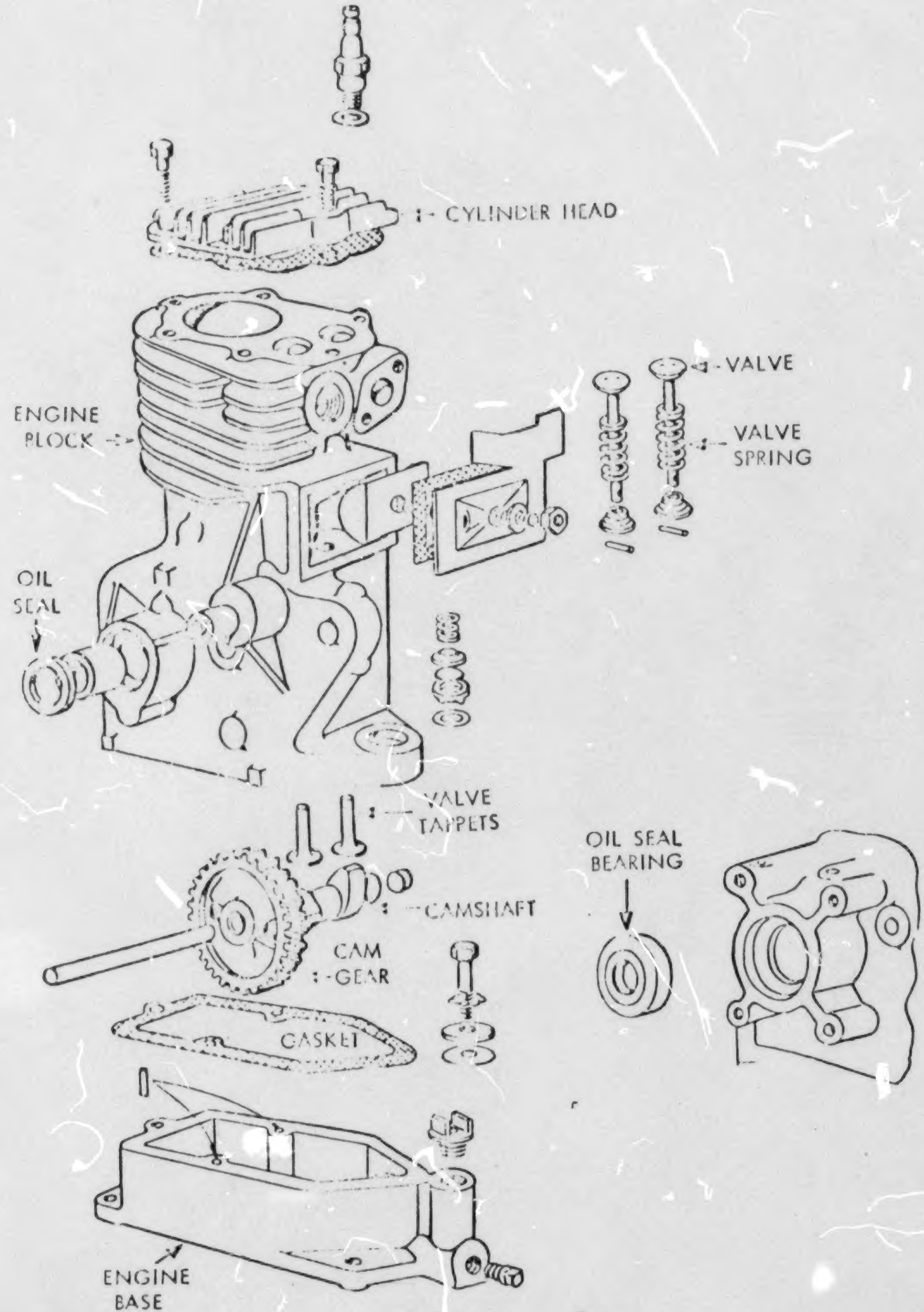
2. Identify the components of a four-stroke cycle engine.





Example transparency/handout Master

Power Mechanics - PISTON ENGINE



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Example transparency/handout Master

SAMPLE JOB SHEET

NAMES

PROJECT:

DATE:

PERIOD

PROCEDURE:

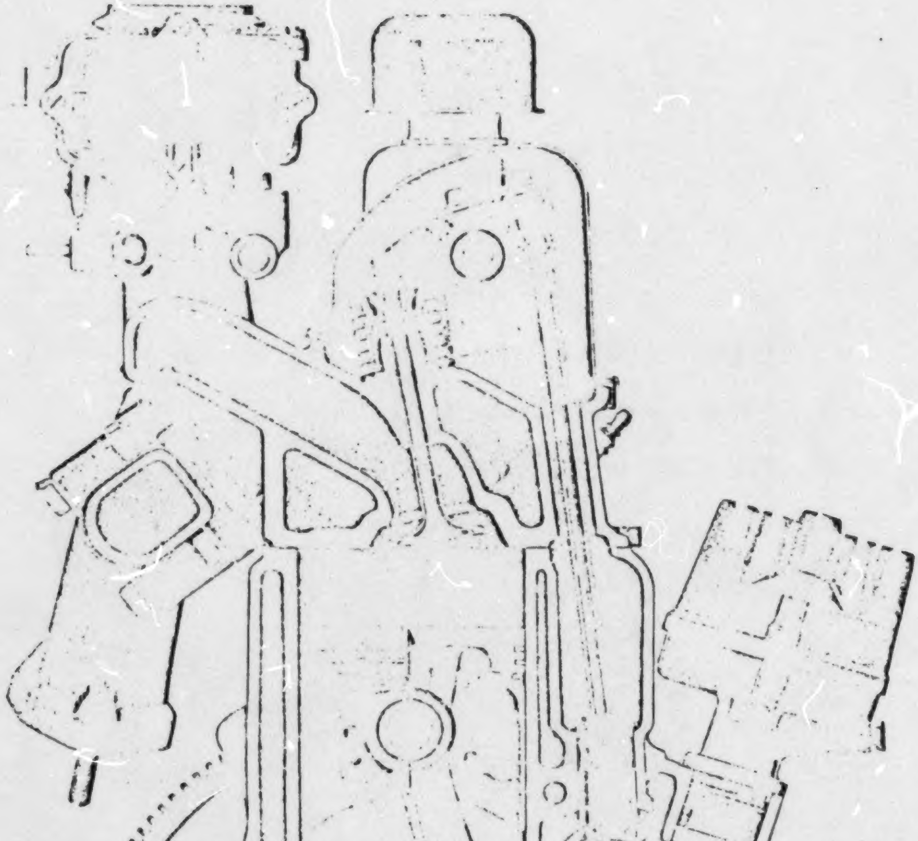
TOOLS REQUIRED:

FOR TEACHER:

Example Job Sheet: One person always rotated from each work group may be selected to record data during shopwork, then the other students can "write-up" the job as a "follow-up" activity. (Note: kept in student's notebook)

May be continued on back

NOTES (Any problems or breakage):



Instructional Aids

The following are from: Bergwall Productions, Inc., 839 Stewart Ave., Garden City, New York 11530:

#450 - Filmstrip Set - "Small Engines Explained" - $231.00

#970 - Filmstrip Set - "Rolling in the Auto Trade"

#971 - Filmstrip Set - "Working in A Service Station"

#453 - "Outboard Marine Engines Explained" - $103.00

#470 - "The 4 Cycle Diesel Engine Explained" - $77.00

From Brodheed - Garrett:

448490 - Zelenda Metric Chart $1.80

A variety of Aids (handouts, transparencies, and charts) can be taken from: Comprehensive Small Engine Repair Student Materials. Stillwater, Oklahoma; Mid-America Vocational Curriculum Consortium, Inc., 1977.

POWER MECHANICS

Suggested Tools Inventory for Power Mechanics

QTY.	BG#	DESCRIPTION	PRICE
1	186950	Small motor tool panel	$146.96
1	32 sp.	Wrenches & snaps panel	204.86
1	31 sp.	Punches & chisels panel	191.20
1	36 sp.	Screwdrivers panel	175.93
1	60 sp.	Flat wrench panel	366.63
1	15 sp.	Soft face hammer panel	178.02
1	52 sp.	1/4 x 3/8" Dr. Sockets panel	526.74
1	45 sp. + 54 sp.	1/2" Dr. Sockets panels	600.12
1	32 sp.	Plier panel	200.49
1	51m-sp.	3/8" x 1/2" Dr. Socket panel	291.75
1	61m'sp	Metric Wrenches panel	206.00
1	444 OR	Retaining righ pliers	16.00
1	3200c	Ignition Set	51.22
1	5-614	American Top & Die set	68.07
1	6312	Metric Top Die Set	75.53
1	S-2938	Drill Index	74.51
1	S-60	Drill Index	49.33
1	S-26	Drill Index	68.16
1	218770	Extractor Sets	15.52
1	QJ-2100B	3/8" Torque Wrench	61.80
1	AW-1020K	American Allen Wrench Set	30.35
1	AWM-140C-K	Metric Allen Wrench Set	28.85
5	GAC-1575	Safety Goggles	9.95
3	HS-8	Hacksaw Frame	28.75
2	HSS-1214	Hacksaw blades	19.80
	HSS-1218	Hacksaw blades	9.90
	HSS-1224	Hacksaw blades	9.90
	HSS-1232	Hacksaw blades	8.75
1	HS-13	Jab Saw	8.45
2	ECF-6	Flush Light/Continity tester	24.90

2	EC826	Extension Cord	41.80
1	PTUO	Pick-up tool	6.35
1	PT-5A	Pick-up tool	2.53
1	HBM-60L	File set	32.14
1	HBK 40K	File Set	25.50
1	GA-98	File Handle	2.58
2	AC-8A	File Card	5.08
1	HBR-40K	File Set	16.46
5	AC-58B	Wire Brush	7.60
2	CS-1	Carbon Scraper	3.80
5	GA-157A	Solvent Brush	17.20
1	CSA-12	Carbon Scraper	6.45
1	CSA-8	Carbon Scraper	5.60
3	PK-22	Scraper	9.00
1	BP-2A	Hammer	7.95
2	BP-16A	Hammer	20.00
1	BP-48A	Hammer	14.95
1	1112	Air Hammer	43.95
1	Ass.	Bits for Air Hammer	50.00
1	486318	1/2" Drill	158.00
1	7510	3/8" Drill	109.00
1	Model 70	Parts Washer	578.75
1	260580	Compressor	457.00

Recommended Texts & Reference Materials

Suggested Texts:

Bohn, Ralph C. and MacDonald, Angus J. *Power: Mechanics of Energy Control*. Bloomington, Illinois, McKnight & McKnight Publishing Co., 1970.

MacDonald, K. L. *Small Gasoline Engines - Student's Workbook*. Indianapolis, Indiana, Howard W. Sams & Co., Inc., 1969.

Pipe, Ted. *Small Gasoline Engines*. Indianapolis, Indiana, Howard W. Sams & Co., Inc., 1973.

Suggested Reference Materials:

Crouse, William H. *Automotive Mechanics*. St. Louis, Missouri, McGraw-Hill Book Co., 5th Ed., 1965

Hawaii, *Industrial Arts Instructional Guide for Power*. Department of Education, Hawaii Office of Instructional Services, 1975.

Hires, Bill, Mark Taylor and Mike Bundy. *Comprehensive Small Engine Repair*. Developed by the Mid-American Vocational Curriculum Consortium, Inc., State Department of Vocational and Technical Education, 1977.

Roth, Alfred C. *Small Gas Engines*. South Holland, Illinois, The Goodheart-Willcox Co., Inc., 1975.

Stephenson, George E. *Small Gasoline Engines*. Albany, New York, Delmar Publishing, 1964.

Stockel, Martin W. *Auto Services and Repair*. South Holland, Illinois, The Goodheart-Willcox Publishing Co., 1969.

Woodward, Robert L. and Norman L. Myers. *Industrial Arts Power Mechanics*. Sacramento, California, California State Department of Education, 1970.

Additional References

Atteberry, Pat H. *Power Mechanics*. South Holland, Illinois, The Goodheart-Willcox Co., Inc., 1968.

Curriculum (Small Engine Repair). Koror, Palau, Micronesian Occupational Center, Instructional Services, Department of Education, Trust Territory of the Pacific Islands, 1972.

School Shop Safety Manual. New York, New York, Curriculum Bulletin #13, Board of Education of the City of New York, 1965.

1974-1980 Johnson/Evinrude Instruction Books (all models). Outboard Marine Corporation, Ken Cook Transnational, 1974.

Kates, Edgar J. Diesel and High Compression Gas Engines. Chicago, Illinois, American Technical Society, 1965.

APPENDIX B

SAMPLE LESSON PLAN

AUTO MECHANICS I

UNIT IV: ENGINE DESIGN AND THEORY OF OPERATION

SUB-UNIT #4: VALVE ARRANGEMENTS

OBJECTIVE #4: The student will be able to explain and discuss the types of valve arrangements.

REFERENCE: Auto Mechanics Fundamentals - C-7 page 169

INSTRUCTIONAL AIDS:

a. Handout information sheets
b. Transparency sheets
c. Point out charts
d. Give test

INSTRUCTOR'S PROCEDURE:

Define and provide the examples of the different valve arrangements.

STUDENT'S PROCEDURE:

a. Study information sheet
b. Take test

INFORMATION SHEET HANDOUT

I. Types and definitions of valve arrangements

A. L-Head - Both valves in the block over the cylinder

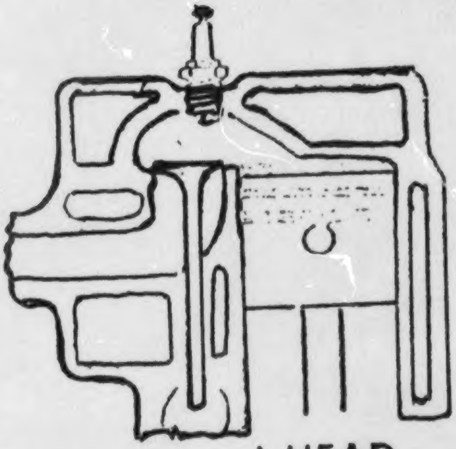
B. I-Head - Both valves in the head over the cylinder

C. F-Head - One valve in the head and the other in the block, both are on the same side of the cylinder.

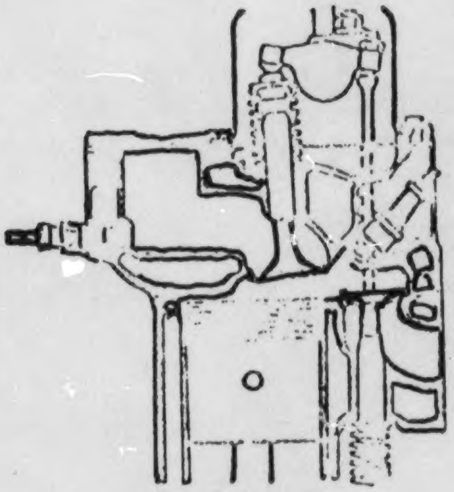
D. T-Head - One valve on one side of the cylinder and the other on the opposite side of the cylinder both in the block

Sample Transparency Master

VALVE ARRANGEMENTS

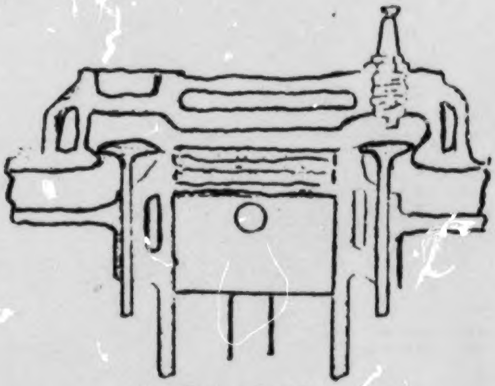


L-HEAD

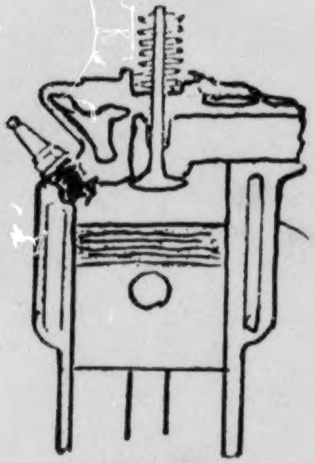


F-HEAD

Sample Transparency Master



T-HEAD

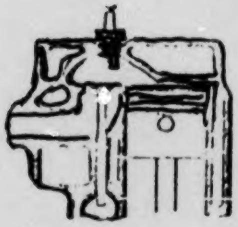


I-HEAD

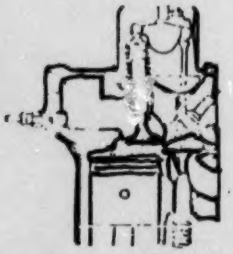
300

SAMPLE TEST

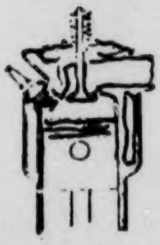
1. Identify the type of valve arrangements:



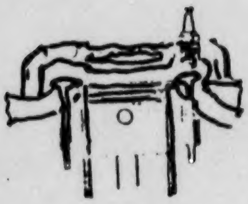
a. ____________________



b. ____________________



c. ____________________



d. ____________________

301

SAMPLE LESSON PLAN

AUTO MECHANICS I

UNIT IX: ALTERNATOR(AC GENERATOR)

SUB-UNIT #11: ALTERNATOR

OBJECTIVE #12: The student will be able to explain the construction of the alternator (AC Generator)

REFERENCE AND MATERIALS:

Auto Mechanics Fundamentals, Chapter 19, page 378-381
Film loops
Alternator-DCA Education Products Inc., No. 4865
Stenton Avenue, Philadelphia, Penn., 19144

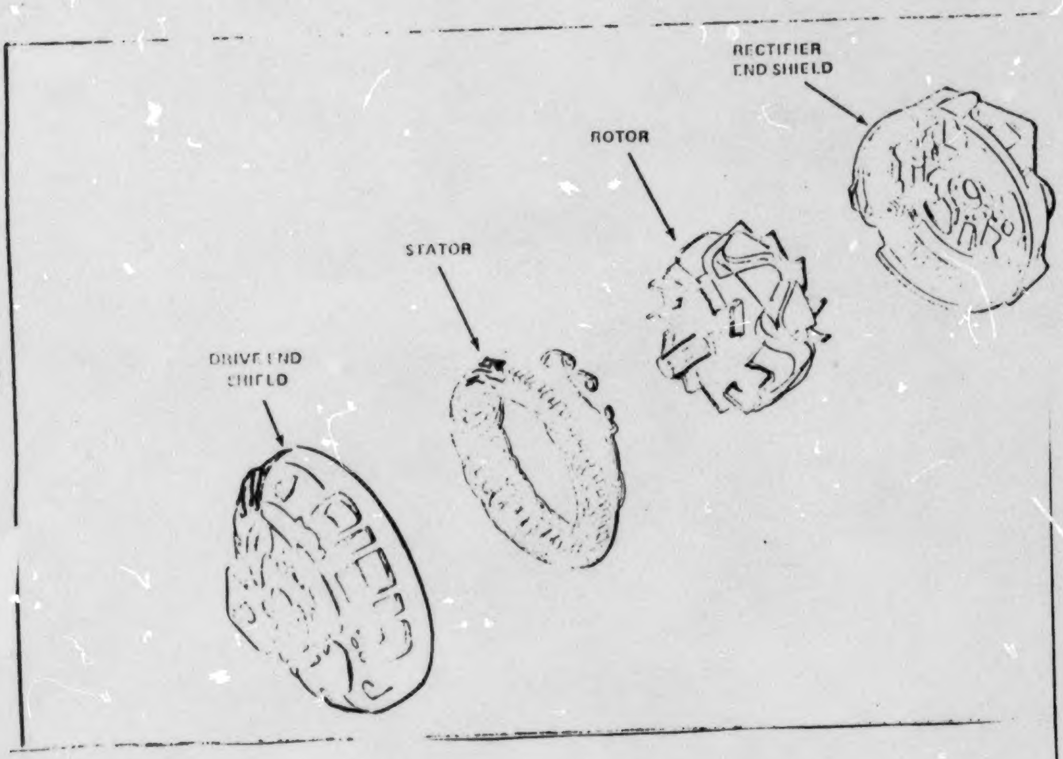
INSTRUCTOR'S PROCEDURE:

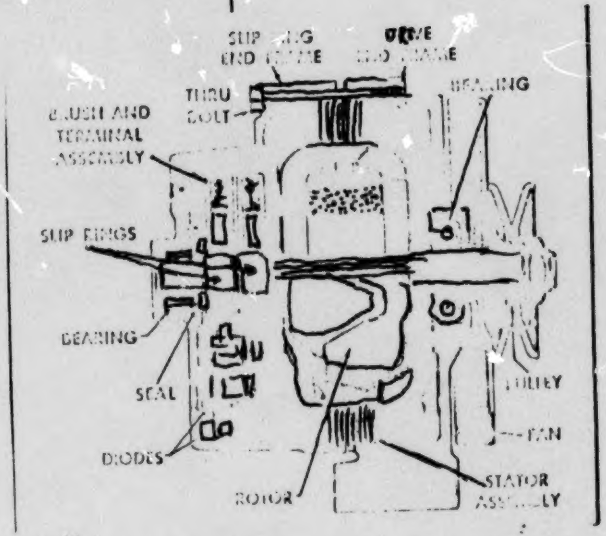
1. Lecture on the construction of the alternator (give handouts)
2. Lecture and using (transparency) of alternator construction
3. Lecture on the film
4. Lecture on shop practice
5. Disassemble alternator

STUDENT'S PROCEDURE:

1. Give each student an alternator to disassemble and identify parts
2. Test

SAMPLE STUDENT HANDOUT





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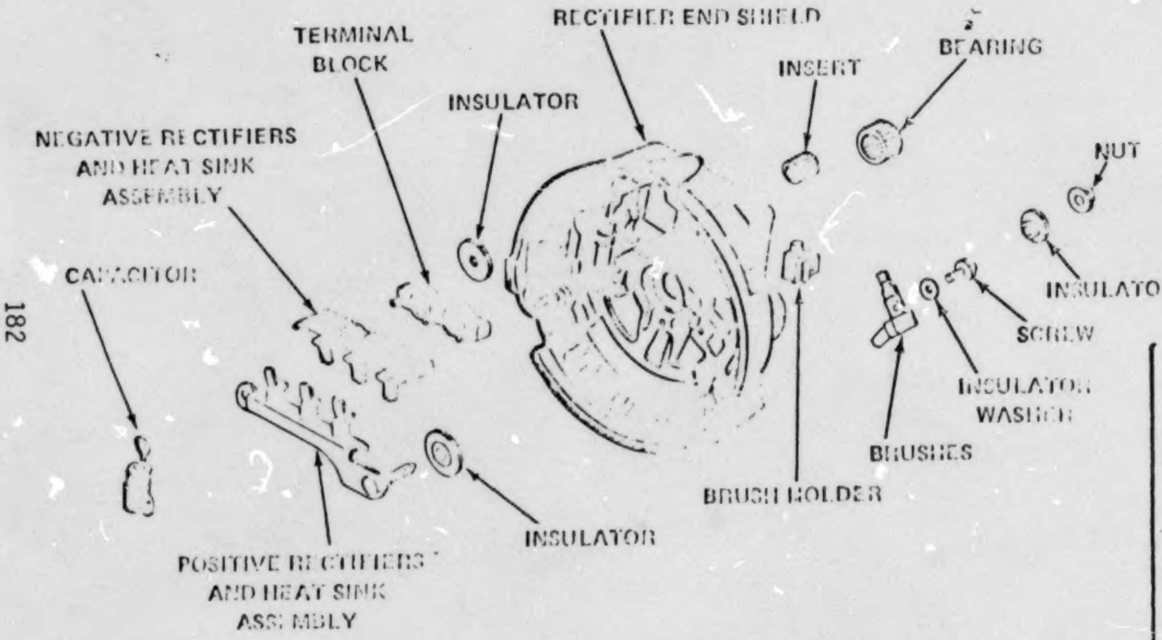

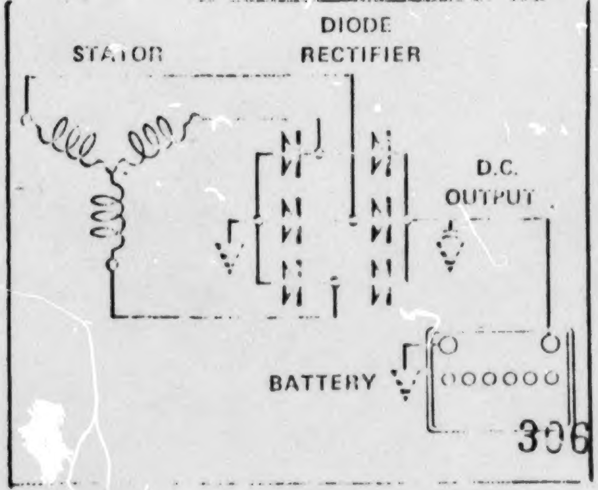

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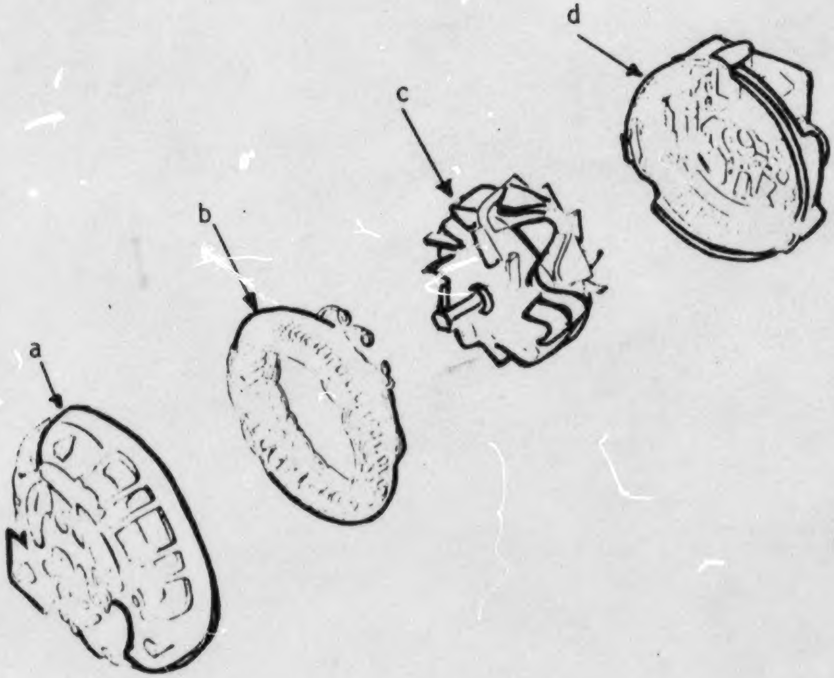

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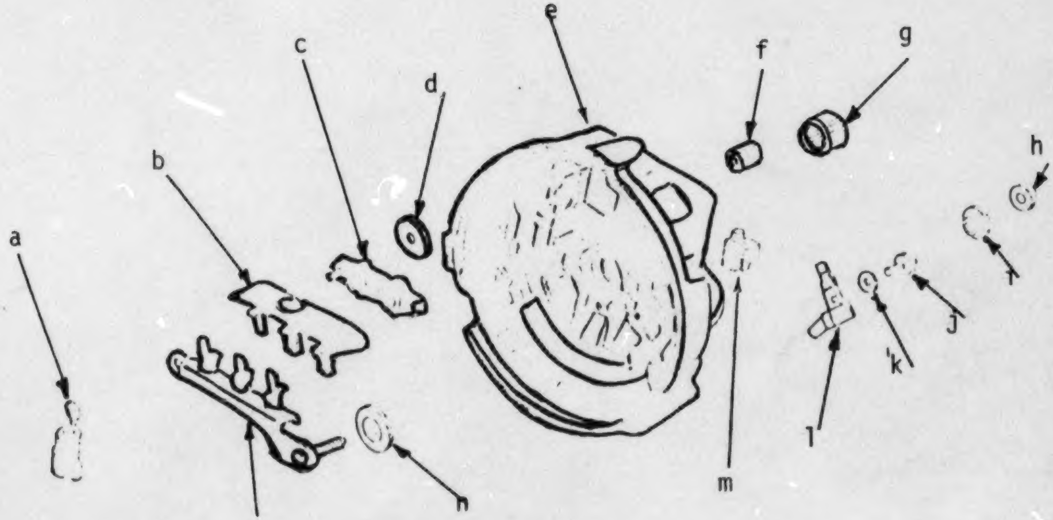


SUGGESTED TOOL LIST

AUTO MECHANICS I

I. Screw Drivers

   a. Standard(slotted)
   b. Phillips
   c. Clutch
   d. Offset

II. Hammers

   a. Ball peen
   b. Soft-face
   c. Sledge
   d. Rawhide face

III. Pliers

   a. Slip-joint
   b. Vice-grip (locking)
   c. Channel lock
   d. Long nose
   e. Stripping (insulators)
   f. Side cutters

IV. Punches

   a. Starter
   b. Pin
   c. Aligning
   d. Center

V. Chisels

   a. Cold
   b. Cape
   c. Diamond Point
   d. Half round

VI. Wrenches

   a. 1 complete set, combination(open-end and box-end) wrench, standard 3/8" to 1"
   b. 1 complete set, combination(open-end and box-end) wrench, Metric 6mm to 20mm
   c. 1 set, deep socket 3/8 drive, standard 3/8" to 1" with handles and accessories
   d. 1 set regular sockets, 3/8 drive, standard 3/8" to 1" with handles and accessories

e. 1 set socket deep, 1/2" drive, standard 3/8" to 1"
f. 1 set socket regular, 1/2" drive, metric 10 mm to 24 mm

VII. Tune-up Tools and Equipment

a. Timing light
b. Compression tester
c. Vacuum tester
d. Dwell tester
e. 1 set, ignition wrench
f. V.O.M. meter
g. Hydrometer

VIII. Files

a. Ignition files
b. Flat, single/double-cut (fine and intermediate)
c. Round, single/double-cut (fine and intermediate)

Suggested Textbooks

1. Stockel, Auto Mechanics Fundamentals, The Goodheart-Willcox Co., Inc., 1974.
2. Stockel, Auto Service and Repair, The Goodheart-Willcox Co., Inc., 1969.
3. William H. Crouse, Automotive Mechanics, McGraw-Hill Book Company, 1970.
4. Jensen, Automotive Drawing Interpretation, Delmar Publishers Inc., Albany, New York.

Suggested Films

1. Cooling System - McGraw-Hill Films, 330 West 22nd Street, New York, New York 10036.
2. Lubricating System - McGraw-Hill Films, 330 West 22nd Street, New Yor, New York 10036
3. Fuel System - McGraw-Hill Films, 330 West 22nd Street New York, New York 10036

APPENDIX C

Auto Mechanics II

UNIT IV ENGINE OVERHAUL & SERVICE

Sub-Unit: 1 Valve Service

Objective #1.5 The student will be able to grind the valve and valve seat within the given spec.

Sub-Objective: The student will be able to recognize seven wearing factors of a valve.

Reference: Auto Service & Repair, by Stockel, Martin W., Chapter 13, page 13-1

Instructional Aids: Intake and exhaust valve, chart, and transparencies

Teacher Activity:

1. Students will look at and understand what cause the seven wear factors
2. Students will read Chapter 13, page 13-1 on cylinder head, valve & valve train service
3. Student using check list will identify wear on 2 valves

Assignment:

1. Answer questions on page 13-139. Auto Service & Repair, by Stockel, Martin W., Copyright 1969 (Homework)

Evaluation:

1. Written exam. Seven wear factors of a valve and five questions taken from Auto Service & Repair, by Stockel, Martin Copyright 1969

Sample Student Check List

A. Indicate with a check ( ) mark which of the valve has the following defects.

B. Indicate with a check ( ) mark which of the following is repairable.

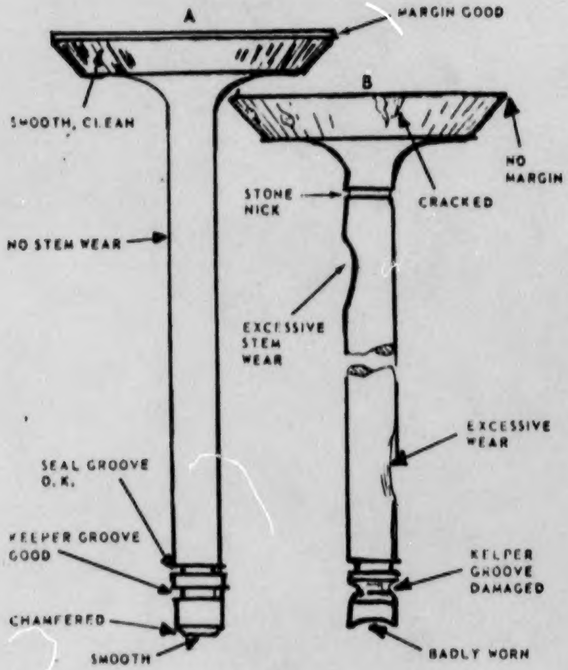
Visual inspection of a set of valve.
Mark the appropriate box.

1. Valve face - pitted
2. Stem wear
3. Valve face - burned
4. Valve face - indented
5. Margin
6. Chamfer
7. Stem runout
8. Valve head runout

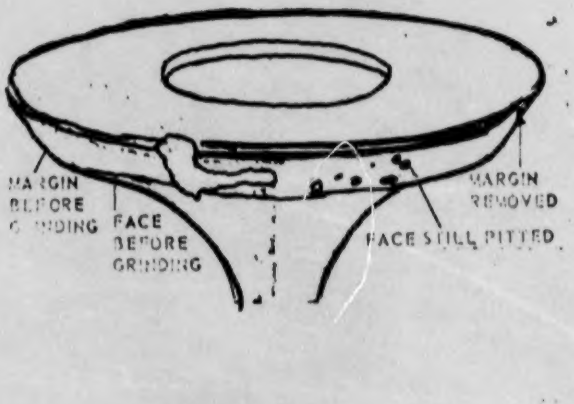
Valve Service

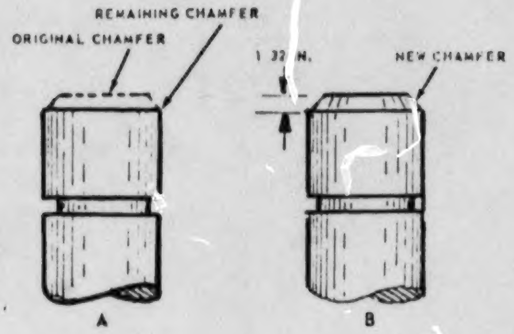
1. Grind valve face
2. Grind valve stem end
3. Measure margin
4. Measure new margin
5. Grind valve set & measured to spec.

Student Name: ______________________________
Date: ___________



SAMPLE TRANSPARENCY
MASTER





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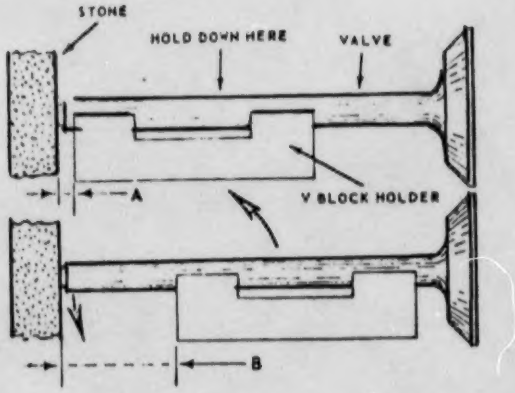
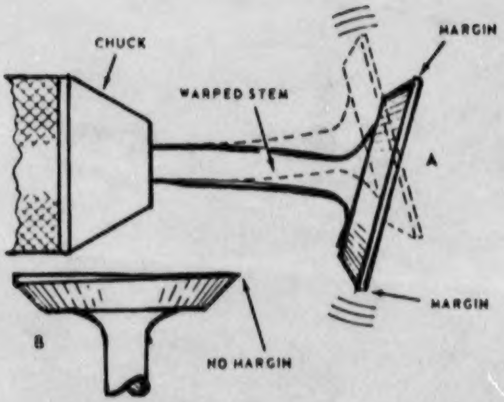




APPENDIX C

SAMPLE LESSON PLAN

AUTO MECHANICS II

UNIT V: ELECTRICAL SYSTEM

SUB-UNIT #B.4: ALTERNATOR (Disassemble for defective parts)

OBJECTIVE #B.4: The student will be able to disassemble and check for defective parts.

REFERENCE: Auto Service and Repair pp. 452-459
Auto Mechanics Fundamentals pp. 385-389

INSTRUCTIONAL AIDS:

a. Ohmmeter
b. Text book (AS & R, pp. 452-459) (AMF. pp. 385-389)
c. Handout on different parts of the alternator
d. Alternator

INSTRUCTOR'S PROCEDURE:

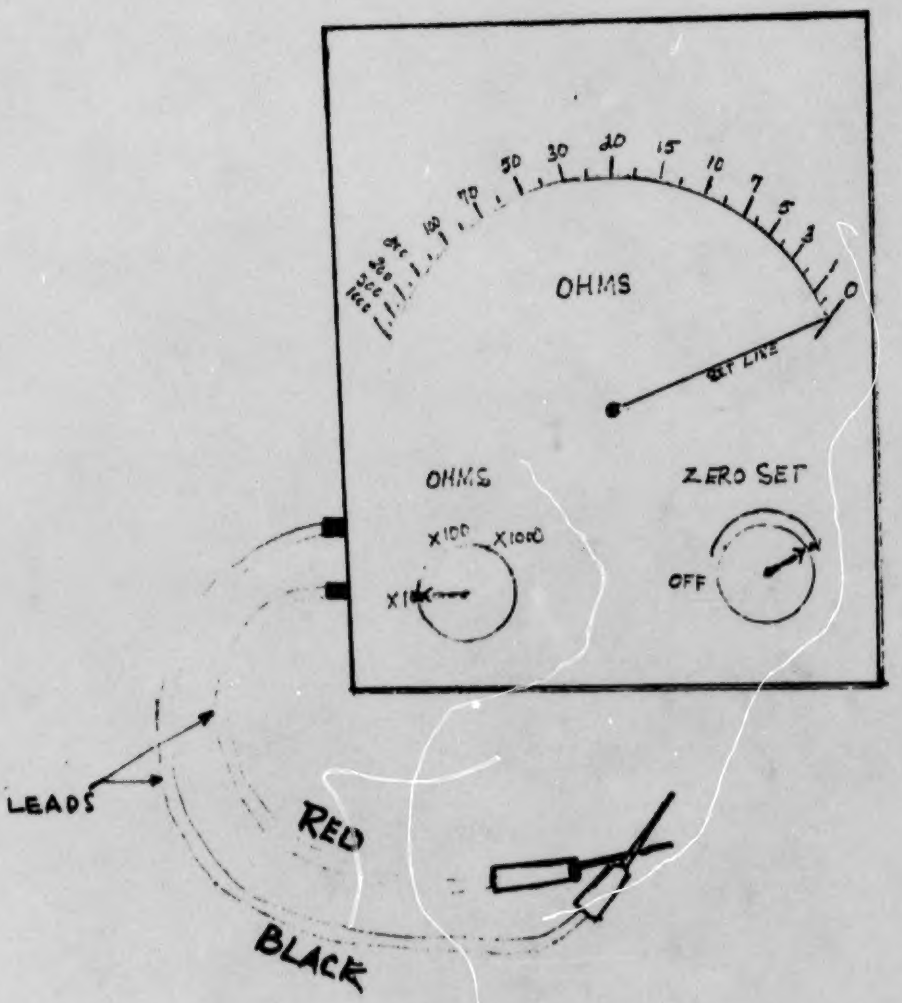
a. Lecture on how to use an ohmmeter
b. Lecture on disassemble and assemble alternator
c. Demonstrate how to check defective parts of the alternator (rotor, stator, and diodes)
d. Handout on the four major parts with inspection and testing

STUDENT'S PROCEDURE:

a. Read text (Auto Service and Repair, pp. 452-459) (Auto Mechanics Fundamentals, pp. 385-389)
b. Disassemble and assemble alternator
c. Use ohmmeter to check defective parts of the alternator
d. Study on the handout and check the major parts by using an ohmmeter.

EVALUATION: Written test and performance test to check if the student learned the lesson.

SAMPLE TRANSPARENCY MASTER



SAMPLE TRANSPARENCY MASTER

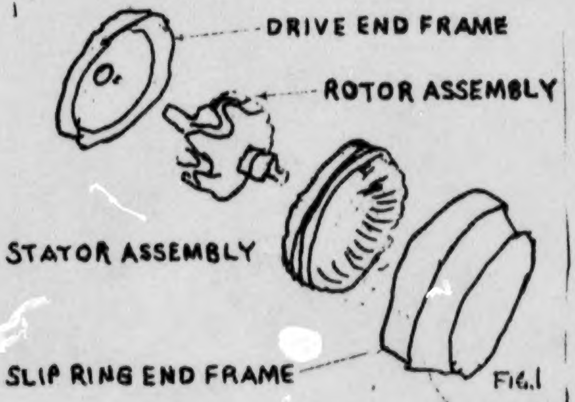
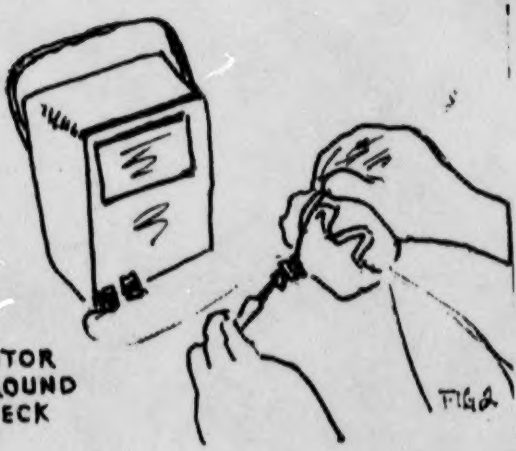


FIG.1



ROTOR
GROUND
CHECK

FIG.2

STATOR OPEN CHECK

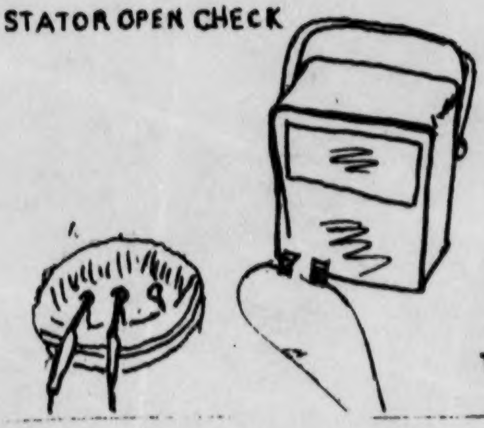


FIG.3

SAMPLE TRANSPARENCY MASTER

STATOR GROUND CHECK

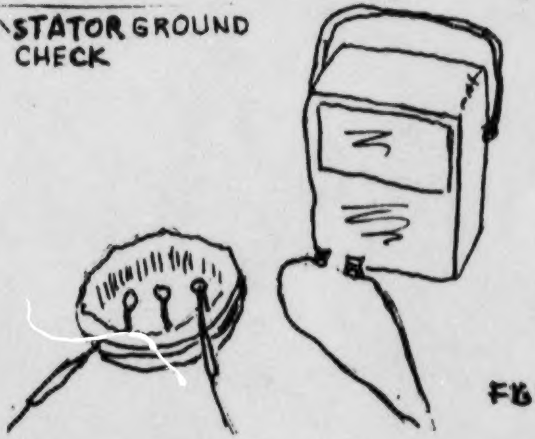


FIG 4

DIODE TRIO TEST

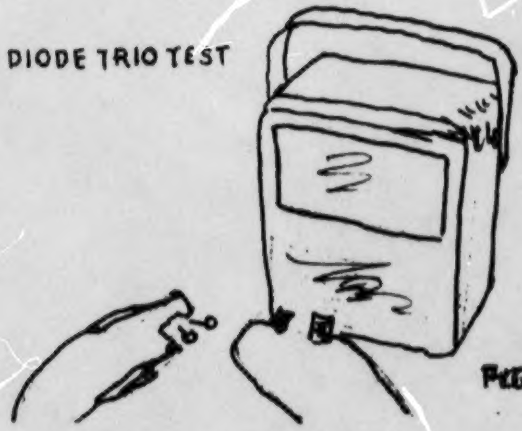


FIG.5

RECTIFIER BRIDGE TEST

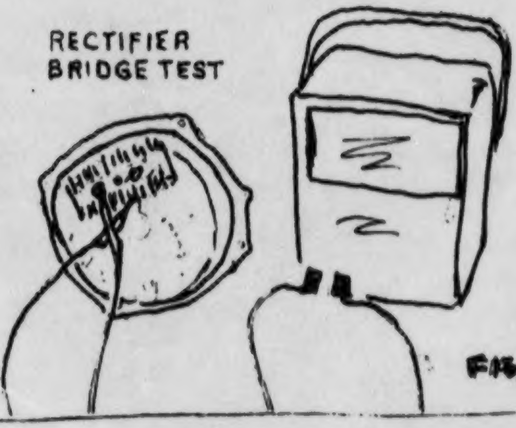


FIG.6

SAMPLE TEST

I. Direction: Answer the following questions.

1. What are the four major components of the alternator?
2. What is the name of meter used to check the parts of the alternator?

II. Direction: True and False. If the statement is True write T, and if the statement is False write F on the blank provided before each statement below.

1. ________The rotor field winding is usually check for open, shorts or grounds.
2. ________If the needle of the ohmmeter does not move, there is an open in the windings.
3. ________To check for a ground, connect both leads of the ohmmeter on the slip ring.
4. ________When checking the stator, shorted stator winding are difficult to locate.
5. ________A good diode trio allow current to pass in both directions.

SAMPLE TRANSPARENCY MASTER

III. Direction: Match the letters on the illustration to the discription below.

1.__________Diode trio test.

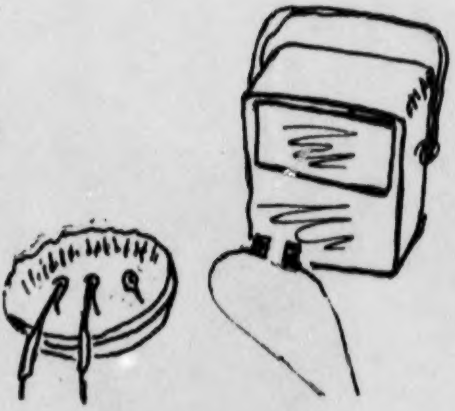
2.__________Stator ground check.

3.__________Rectifier bridge test.

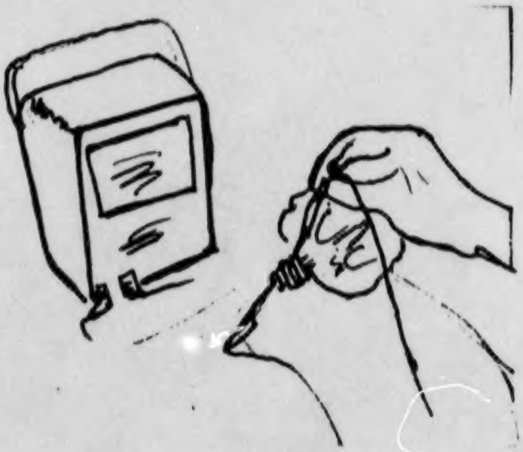
4.__________Stator open check.

5.__________Rotor ground check.

A

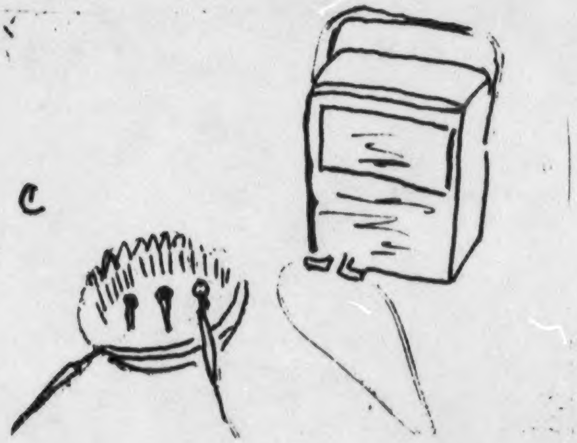


B

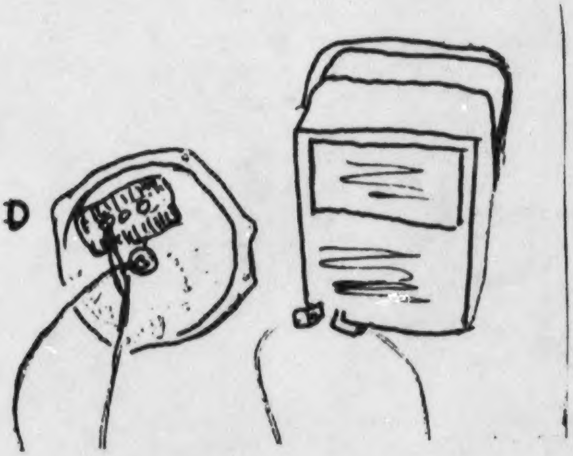


SAMPLE TRANSPARENCY MASTER

C



D



E

TOOL LIST

AUTO MECHANICS II

I. System of Measurement

- a. American Standard
- b. Metric

II. Basic Hand Tools

- a. 1 set flare nut wrench 3/8" to 1/2"
- b. 1 set ratchet box end
- c. 1 set combination wrench 3/8" to 1 1/4"
- d. 1 set open end wrench 3/8" to 1 1/4"

III. Socket Handles

- a. 1 each 1/2" drive speed handle
- b. 1 each 3/8" drive speed handle
- c. 1 each 1/2" drive flex handle
- d. 1 each 3/8" drive flex handle
- e. 1 each 1/2" drive sliding T-handle
- f. 1 each 3/8" drive sliding T-handle
- g. 1 each 1/2" drive spinner handle
- h. 1 each 3/8" drive spinner handle
- i. 1 each 1/2" drive ratchet handle
- j. 1 each 3/8" drive ratchet handle

IV. Socket Wrenches

- a. 1 set 6 pt. 1/2" drive swivel sockets 3/8" to 3/4"
- b. 1 set 12 pt. 1/2" drive deep sockets 3/8" to 7/8"
- c. 1 set 6 pt. 3/8" drive standard sockets 3/8" to 7/8"
- d. 1 set 12 pt. metric wrenches 10 mm to 22 mm
- e. 1 set 6 pt. metric wrenches 10 mm to 22 mm

V. Pliers

- a. Combination slip joint
- b. Vise gripe
- c. Ignition plier
- d. Rib joint plier
- e. Diagonal
- f. Electrician
- g. Chain nose
- h. Needle nose

VI. Cleaning Tools

a. Carbon brush
b. Wire brush
c. Wire wheel
d. Flexible scraper
e. Twisted strand wire brush
f. Bristle head
g. Rigid scraper
h. Bristle brush and holder
i. Arbor for wire wheel
j. Cleaning brush with nylon bristles
k. Hand wire scratch brush

VII. Special Tools

a. Feeler gauge
b. Spark plug gauge
c. Micrometer
d. Hydrometer
e. Electric drill with set of drill bits
f. Timing light
g. Compression tester
h. Ohmmeter
i. Tap and die
j. Brake cylinder hones and stones
k. Cylinder ridge reamers
l. Three-arm cylinder hones
m. Ring compressor
n. Piston ring spreader
o. Piston ring groove cleaner
p. Valve grinder set and pilots
q. Valve lifter
r. Puller set

APPENDIX D

APPENDIX D

LESSON PLAN

UNIT #V - WELDING

Sub-Unit # 2.a: Set up/Shut down

Contact Time: 45 minutes class - 45 minutes shop - 30 minutes test and evaluation

Main Performance Objective: The student will be able to complete, to the instructor's satisfaction, the following operations: Steel fusion welding, Brazing, and Torch cutting; on pieces varying in thickness, shape, and location; particular to automotive repair.

Specific Performance Objectives: At the completion of this unit, the student will be able to:

- Demonstrate proper set-up and shut-down of an oxy-acetylene welding station
- Identify and explain safety hazards and considerations related to the setting up and tearing down of an oxy-acetylene welding station.
- Identify and explain the purpose of each component necessary for oxy-acetylene welding operations.
- Determine tip selection, pressure settings, and rod selection for various welding operations.
- Ignite and adjust an oxy-acetylene torch to a neutral flame.
- Complete test with 75% accuracy

Teacher's Responsibilities: Prepare and deliver lecture/discussion on equipment and safety considerations.

Prepare for and deliver demonstration on set-up and shut-down procedure.

Prepare related handouts, transparencies and charts. (See Instructional Aids)

Preview, show, and discuss film and filmstrips.

Prepare, deliver and evaluate/review test.

Student Activities:

Attend and take notes on class lecture/discusstion.

View film and filmstrip

Watch demonstration

Set-up, ignite torch, adjust flame, and shut-down oxy-acetylene welding outfit, in small groups.

Analyze a series of various welding jobs to determine proper tip, correct rod, and appropriate pressure regulation of gases.

Answer a variety of associated questions during the shop activity.

Complete test.

Instructional Aids:

Cassette and filmstrip set - "Oxygen-Acetylene Safety and Set-Up"; Mafex Associates, Inc. Publishers, 90 Cherry St., Box #519, Johnstown, PA 15907. ($31.00)

Films: Guide from WCCC - #629.2

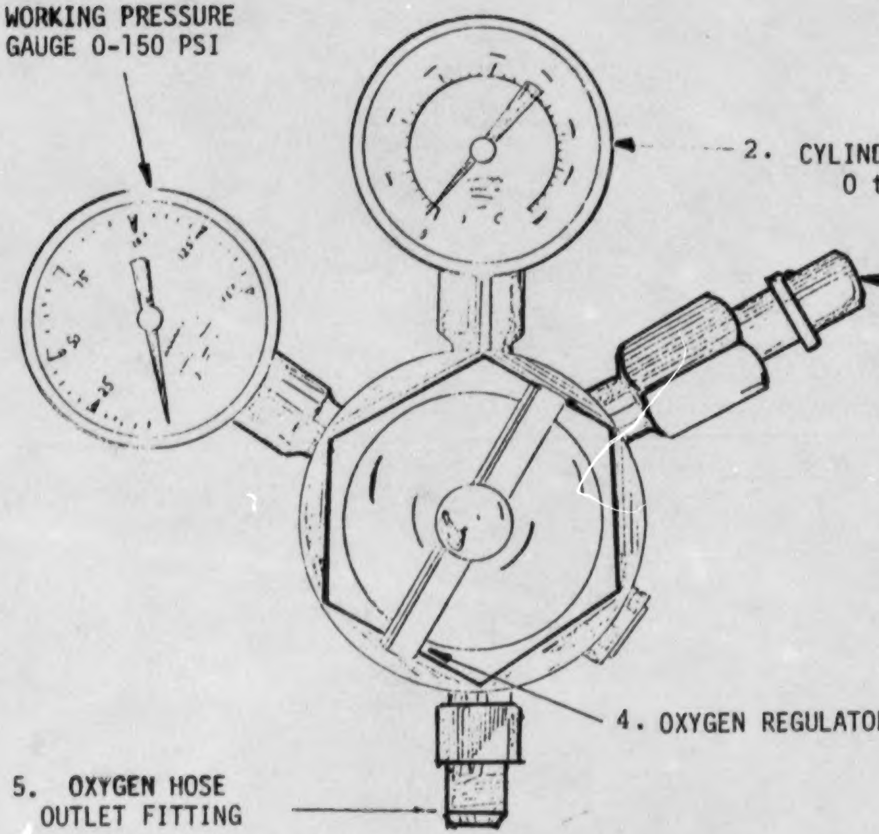
Handouts & transparencies: Oxy-acetylene Welding Outfit", "Oxygen Regulator", "Acetylene Regulator", "Steps for Lighting the Oxy-acetylene Torch", "Acetylene welding", #671.5 WCCC.

Charts, handouts and transparencies: "Gas Welding Tip Numbers and Their Orifice Drill Sizes", "Welding Specifications".

Test

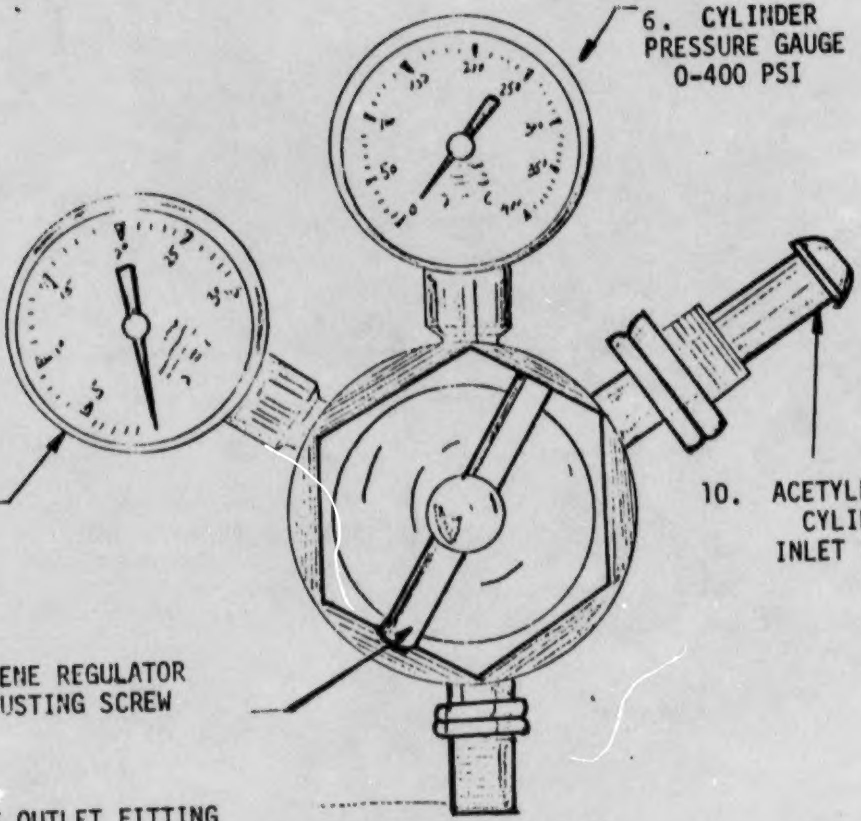
Textbook:	Althouse, Turnquist, and Bowditch. *Modern Welding* , The Goodheart-Willcox Co., Inc., South Holland, Ill., 1970. Chapter 1, pp. 12-15)
Tools and Equipment:	Overhead projector, filmstrip viewer with cassette function, 16 mm projector, One (1) Oxy-acetylene Welding outfit for every 4 students, including associated tools and a variety of welding tips.

OXYGEN REGULATOR


1. WORKING PRESSURE GAUGE 0-150 PSI
2. CYLINDER PRESSURE GAUGE 0 to 3000 PSI
3. OXYGEN CYLINDER INLET FITTING
4. OXYGEN REGULATOR ADJUSTING SCREWS
5. OXYGEN HOSE OUTLET FITTING

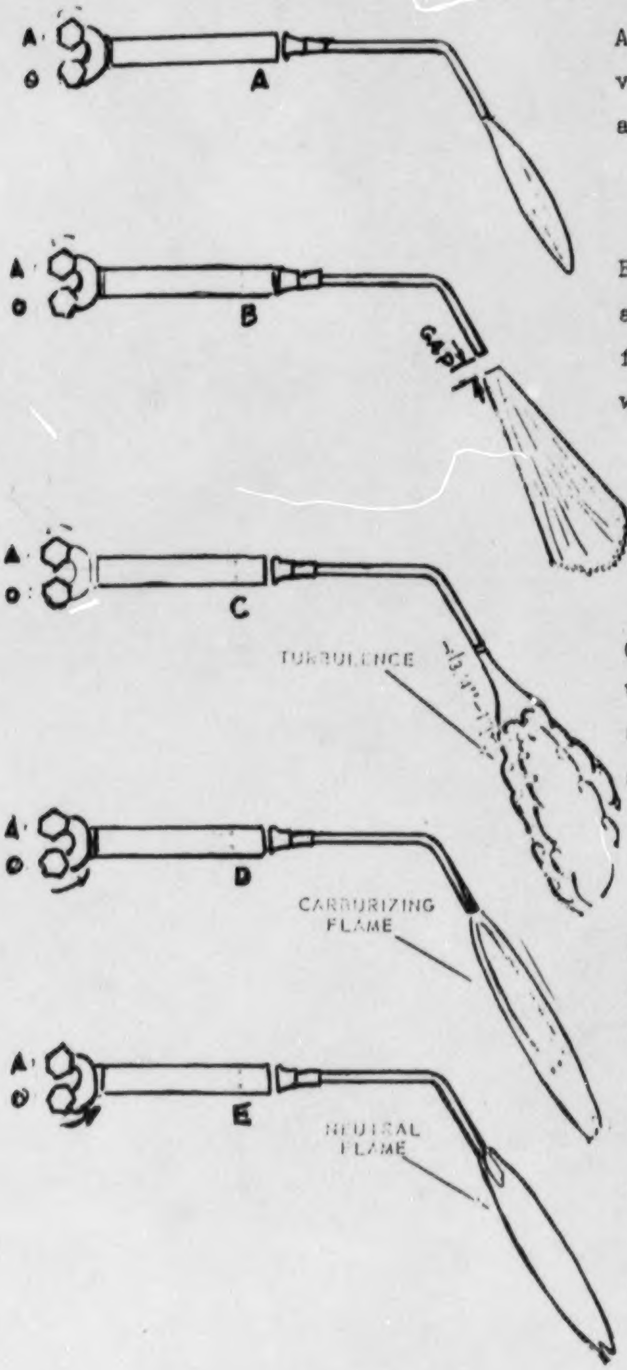
Suggested Master for Transparency and Handout

ACETYLENE REGULATOR


6. CYLINDER PRESSURE GAUGE 0-400 PSI
7. WORKING PRESSURE GAUGE 0 to 30 PSI
8. ACETYLENE REGULATOR ADJUSTING SCREW
9. ACETYLENE HOSE OUTLET FITTING
10. ACETYLENE CYLINDER INLET FITTING

Suggested Master for Transparency and Handout

STEPS FOR LIGHTING AN OXY-ACETYLENE TORCH



A. Open the acetylene torch valve slightly and light the acetylene with a spark lighter.

B. The correct amount of acetylene is flowing if the flame jumps away from the tip when the torch is shaken.

-OR-

C. As shown here, a turbulence is created in the acetylene flame and sooty smoke is eliminated.

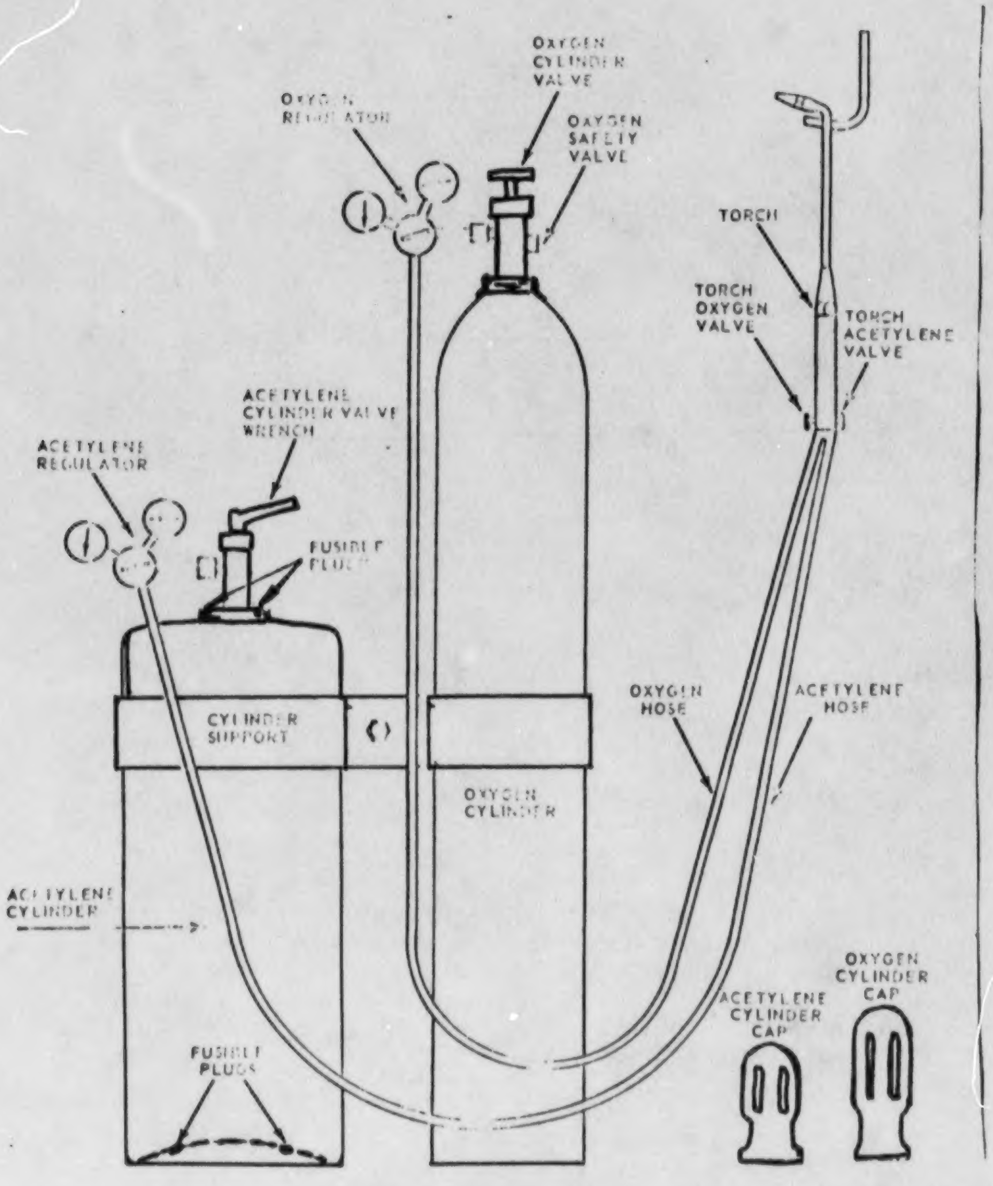
D. Begin turning on the Oxygen by opening the torch Oxygen valve.

E. Continue to turn on the oxygen torch valve until the middle flame is eliminated and a rounded inner cone is seen.

Suggested Transparency and Handout

APPENDIX D

OXY-ACETYLENE WELDING OUTFIT



Suggested Transparency and Handout

Suggested Test (pg. 1 of 2)

-Short Answers-

1. How do you check for leaks in an oxy-acetylene welding outfit?

2. List steps required for lighting an oxy-acetylene torch.

3. List six steps to be followed when shutting down an oxy-acetylene torch.

4. Why should the oxygen cylinder valve be opened slowly when the regulator is in place?

5. Define and explain the purpose of purging the cylinder valve and hoses.

-Circle best Answers-

6. Regulator adjusting screws should be adjusted (OUT) - (IN) before opening cylinder valves.

7. The color red always indicates (OXYGEN) - (ACETYLENE) within an oxy-acetylene welding outfit.

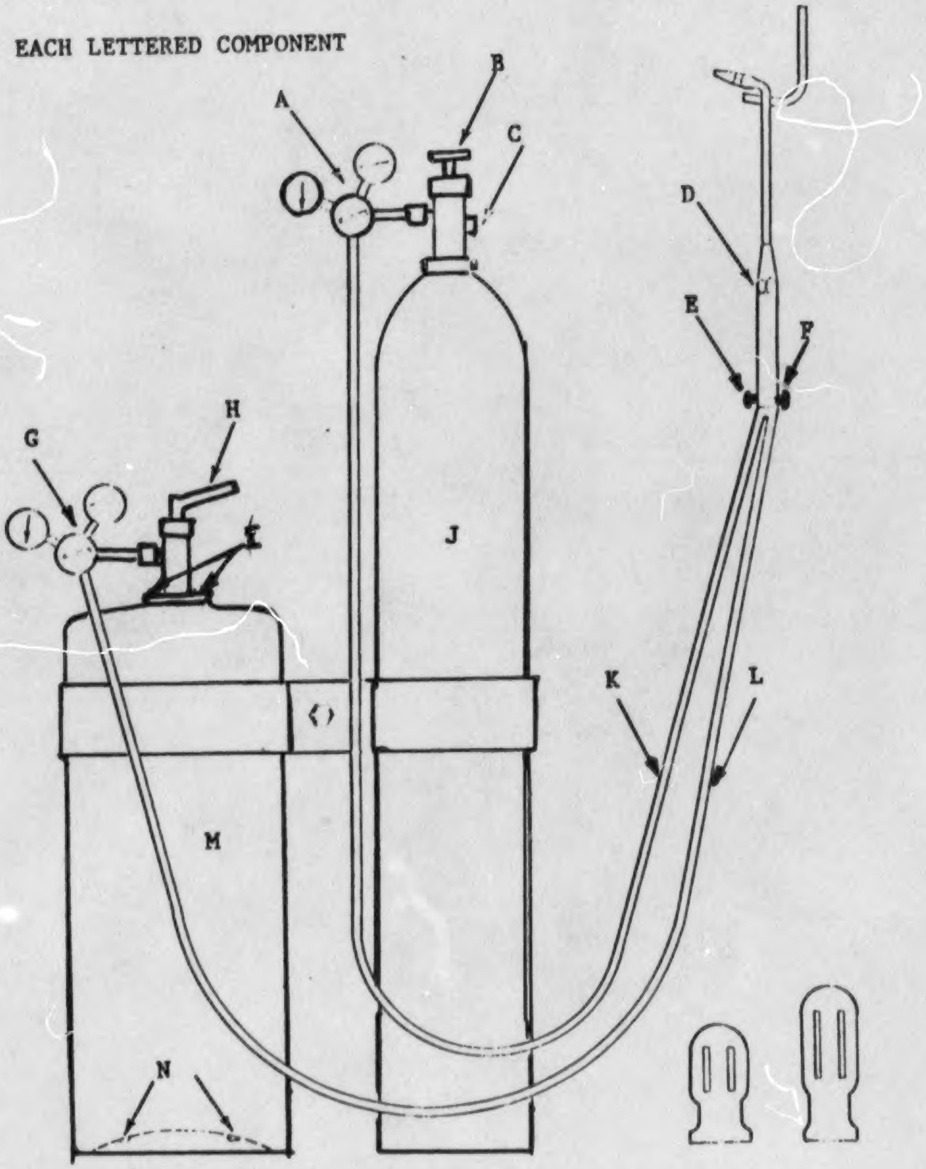
8. The acetylene regulator can best be identified by the capacity of its cylinder pressure gauge, which is much (LOWER) - (HIGHER) than the oxygen regulator cylinder pressure gauge.

9. When welding 3/8" mild steel you would use a (#1) - (#10) - (#6) AIRCO brand tip.

10. The (OXYGEN, - ACETYLENE) tank valve is opened all the way out until it stops lightly.

Suggested Test (pg.2 of 2)

IDENTIFY EACH LETTERED COMPONENT



Lesson Plan

UNIT VI BODY FENDER AND PAINTING Auto III

SUB-UNIT #3. Methods of Body Repair

Unit #a. Shrinking

OBJECTIVE: #1.a. The student will be able to describe all the methods of shrinking techniques.

TEACHER ACTIVITIES:

1. Lecture from the text on shrinking methods, J.A. Tait, A.G. Duroche, N.N. Hilderbred, The Principles of Auto Body Repairing and Painting, Prentice-Hall, Inc., 1976, pages 178-185.

2. Explain terms and definitions (Handout on terms)

3. Explain the shrinking procedures (Handout)

4. Explain functions of the tools and their proper uses. (Handout on shrinking tools).

5. Perform demonstrations on shrinking using heat.

STUDENT ACTIVITIES:

1. Read textbook, J.A. Tait, A.G. Deroche, N.N. Hilderbred, The Principles of Auto Body Repairing and Painting, Prentice-Hall, 1976, pages 178-185.

2. Perform demonstrations (Have student perform demonstrations on car panel, or door for psychomotor skills).

3. Perform demonstrations using heat to shrink.

4. Take written test

Equipment needed

1. Oxy-acetylene torch

TERMS AND DEFINITIONS (HANDOUTS)

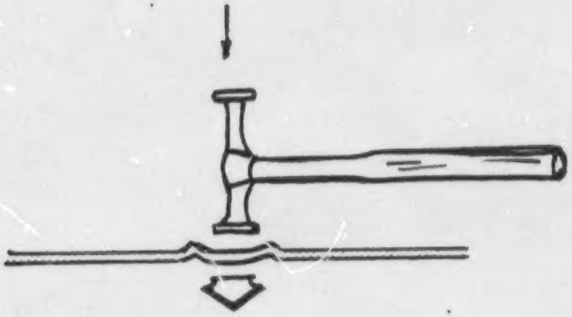
1. Shrinking = an operation where stretched areas on damaged autobody parts and panel are disposed of and brought back, as nearly as possible, to their original shape and size

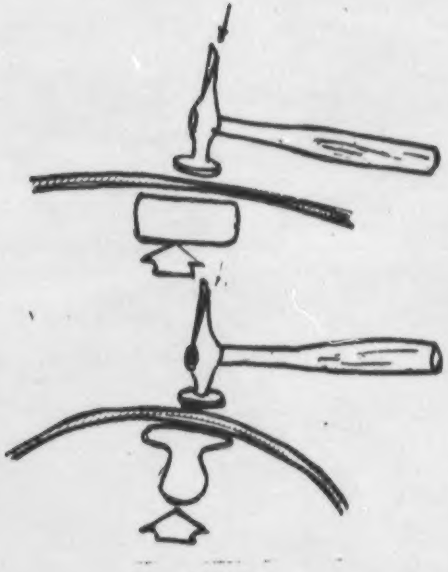
2. Hand feeling = running a palm of the hand over the roughed-out metal

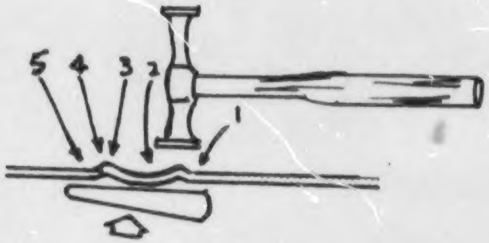
3. Heat shrink = drawing of surplus heat out of the panel and prevent it from spreading into the damaged sections (examples: asbestos cement).

4. Quenching = to cool (as heated metal) suddenly by immersion in oil or water.

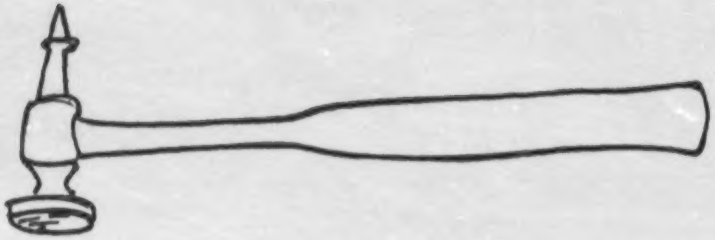
Shrinking Step - Handout

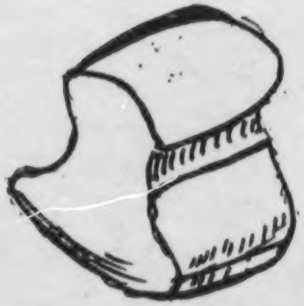


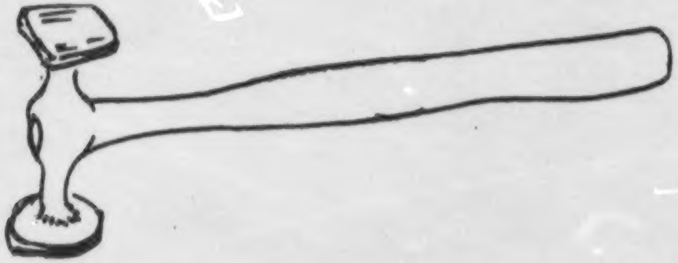




Shrinking Tools - Handout







APPENDIX D

SAMPLE TEST

1. List at least 3 types of tools used in shrinking techniques.
2. List type of heat used in shrinking techniques.
3. Why should red-hot shrink spot not be quenched before they have turned black in color?
4. What does the shrinking operation accomplished in Autobody repairing?
5. List the steps to be followed in shrinking techniques.

Suggested Special Tools and Power Tools

I. Torque Wrenches

   A. Inch pound
   B. Foot pound

II. Taps and Dies

   A. 1-complete set, metric
   B. 1-complete set, standard

III. Hammers

   A. Light bumping hammer
   B. Balanced dinging hammer
   C. Long & short pick hammer
   D. Curved chisel pick hammer
   E. Long roof pick hammer
   F. Heavy-duty fender bumping hammer

IV. Dolly Blocks

   A. General - purpose dolly
   B. Low-crown dolly
   C. Heel dolly
   D. Toe dolly

V. Pick

   A. Long curved pick
   B. Long tee handle chisel pick
   C. Deep-throat straight pick

VI. Grinders

   A. Sander
   B. Grinder

VII. Spray gun and Accessories

VIII. Paint

   A. Different types of Auto paint
   B. Under-coating

Auto Mechanic III

Suggested Textbooks

1. Stockel, Auto Mechanics Fundamentals, Goodheart-Willcox Co., Inc., 1974.
2. A.D. Althouse, C.H. Turnquist, W.A. Bowditch, Modern Welding, Goodheart-Willcox, 1970.
3. A. Tait, A.G. Deroche and N.N. Hildebrand. The Principles of Autobody Repairing and Repainting, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1976.
4. Stockel, Auto Service and Repair, The Goodheart-Willcox Co., Inc., 1969.
5. William H. Crouse. Automotive Mechanics, McGraw-Hill Book Company, 1970.

Suggested Films

1. Shop Safety - 16 mm Film (sound)
2. Tools, Metalwork - 16 mm Film (sound)

I. Basic handtools needed for maintenance and repair small engine.

- A. Basic handtools
  - 1. Hammers
    - a. Ball pen - one pound
    - b. Soft face
  - 2. Pliers
    - a. Slip joint
    - b. Diagonal cutting
    - c. Lock ring
    - d. Needle nose
    - e. Snap ring
    - f. Vise grip
  - 3. Screwdrivers
    - a. Standard slot type
      - 1) 4"
      - 2) 1 1/2"
      - 3) 6 "
      - 4) 8 "
    - b. Phillips
      - 1) 1 1/2 "
      - 2) 6 "
      - 3. 8 "
    - c. Offset
    - d. Clutch head
  - 4. Wrenches
    - a. Adjustable
    - b. Allen-set 5/64" to 1/4"
    - c. Open-end set including 3/8", 1/2", 9/16", 5/8" and 3/4"
    - d. Combination set 3/8", 7/16", 1/2", 9/16", 5/8", 3/4", 7/8"
    - e. Torque - inch pound 3/8" drive
    - f. Combination set-metric
  - 5. Center punch
  - 6. Cold chisel
  - 7. Universal joint

9. Socket sets
    a. 3/8" drive standard
    b. 1/4" drive standard
    c. 3/8" drive metric
    d. Spark plug deep 13/16" by 3/8" drive & 3/4" by 3/8" drive
10. Feeler gauges
    a. Flat
    b. Wire
11. File
12. Parts scraper

B. Other Tools

1. Battery hydrometer
2. Battery post cleaner
3. Battery spring
4. Parts cleaning brush
5. Wire brush
6. Funnel
7. Flywheel holder
8. Ignition wrench set
9. Thread repair insert

II. Standard Overhaul Tools

A. Piston ring expander

B. Piston ring groove cleaner

C. Power drill

D. Punch and chisel set

E. Ridge reamer

F. Ring Compressor

G. Steel rule - 6"

H. Twist drill bit

I. Valve grinders

    - a. Manual
    - b. Power driven
  - J. Valve lapping tools
    - a. wood handle
    - b. crank handle
  - K. Valve seat cutters
    - a. manual
    - b. power
  - L. Valve spring compressor
    - a. small engine
    - b. lever type
  - M. Telescoping gauge
  - O. Micrometer
  - P. Valve guide reamer
  - Q. Pullers
    - a. bearing
    - b. flywheel
  - R. Cylinder hone
  - S. Impact drive
  - T. Clutch wrenches

- III. Types of Torque Wrenches
  - A. Signaling
  - B. Direct reading
- IV. Other Tools
  - A. Safety glassed
  - B. Bench grinder
  - C. Bench
  - D. Broom
  - E. Dust pan
  - F. Bench vise

G. Hacksaw frame and blades

H. Sand papers

V. Special Tools

A. Truarc pliers (internal type)

B. Seal installer

C. Spark tester

D. VOM meter

E. CD ignition adapter

F. Heli coil & insert

G. Coil ring

H. Timing fixture

I. Flywheel puller (OMC type)

APPENDIX E

LESSON PLAN

UNIT TITLE: I ORIENTATION - Small Engine I

SUB-UNIT: Definition of Small Engine Mechanics

OBJECTIVE: Student will be able to define what is Small Engine Mechanics.

REFERENCES: Small Gasoline Engine. (Training Manual) by Ted Pipe, Chapter 1, pg. 13.

INSTRUCTIONAL AIDS: Transparency on three (3) different types of Small Engines & List their names on the board.

TEACHER'S ACTIVITIES: Lecture, asking & answering questions, present transparency, give oral test.

STUDENT'S ACTIVITIES: Listen to lecture, take notes, asking questions when there are questions, prepare a list of other types of Small Engines not covered in class, and take the oral test.

METHODS OF PROCEDURES:

1. Ask if anyone knows about Small Engine, if yes, ask to define Small Engine for the whole class. If none, then go on to the next step.
2. Give lecture on the definition of Small Engine as stated in Chapter 1, page 13, of the reference.
3. While your lecture on the definition is still going on, show them the transparency on the three different types of Small Engines, point out that these are only three types out of many other types of Small Engine which are not included.
4. On the board, list down the names of the three types of Small Engine in the transparency and point out the reason they are called Small Engines.
5. Ask for questions and if there any, answer them, if there are none, go on and ask about five students to describe Small Engine in a random order.
6. If they still don't quite understand, then proceed on a discussion on the definition and give more examples until you are sure that they all get the definition of Small Engine Mechanics.

7. Give each one oral test.

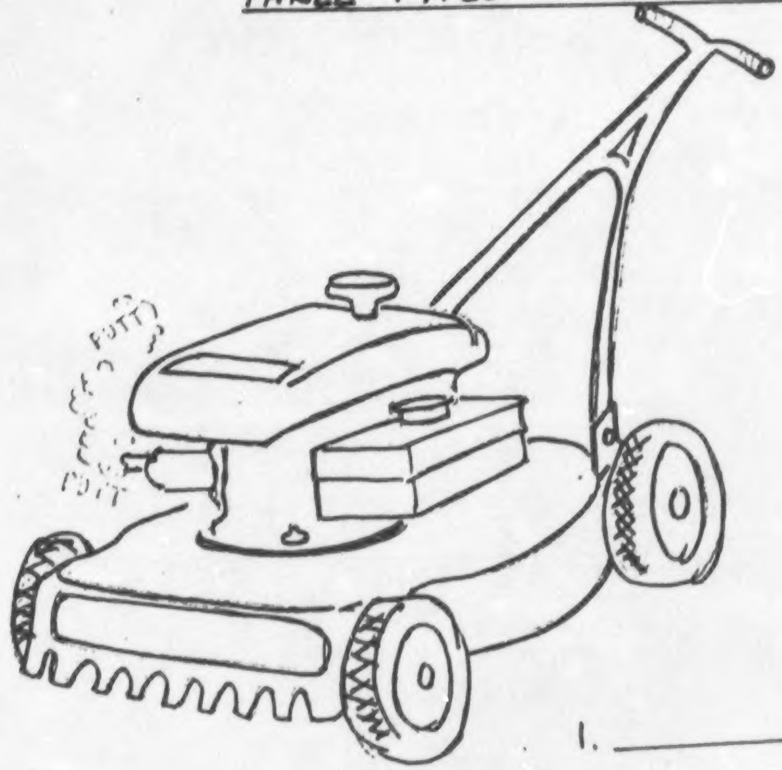
ASSIGNMENT: Have each student prepare a list of other types of Small Engine which you didn't talk about in class to be collected and discussed in tomorrow's class.

EVALUATION: Oral exam. (test) - each student will come up to the teacher's desk one by one and in his/her own words define what is Small Engine Mechanics.

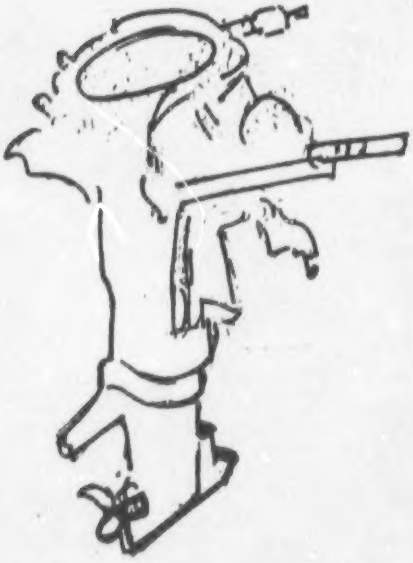
NOTE: Since this is the very beginning of this course, by giving each student a oral test the teacher can get more acquainted with each individual student. Also, this might be a very good time for the teacher to check on each individual's strength and weakness such as in: listening, speaking, etc., so that the teacher can plan his lessons in terms of meeting the needs of each individual. While the test is being conducted, those students not involved will have to start working on their assignment for tomorrow.

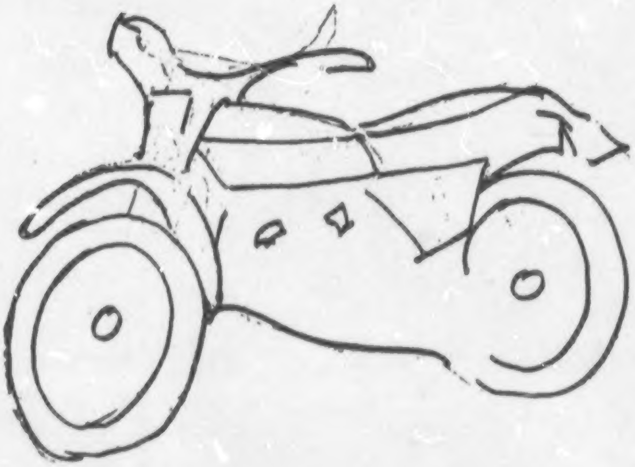
APPENDIX E

THREE TYPES OF SMALL ENGINES



1. ____________________





2. ____________________

3. ____________________

UNIT X LUBRICATING SYSTEM Small Engine I

Sub-Unit # 1: Purposes of the lubrication system

Objective #1: The student will be able to describe the purpose of the lubrication system.

Teacher lecture on how:

1. Oil lubricates the engine
2. Oil helps cool the engine
3. Oil helps clean the engine
4. Oil provides the seal

Use transparencies:

1. Oil lubricates
2. Oil cleans the steel

Handout:

1. Purpose of the lubrication system

Student Activities:

1. Read: Small Gas Engine, Alfred C. Roth, pages 89-91.
2. Read the handout sheet
3. Test on purpose of lubrication system

HANDOUT

Purpose of Lubrication System

1. Oil reduces wear of moving parts by preventing metal to metal conduct. It acts as a liquid ball bearing to reduce friction.

Oil lubricates

2. Oil absorbs heat while circulating through and around the various parts. The absorbed heat is transferred to the air, and to the reservoir of oil.

oil cools

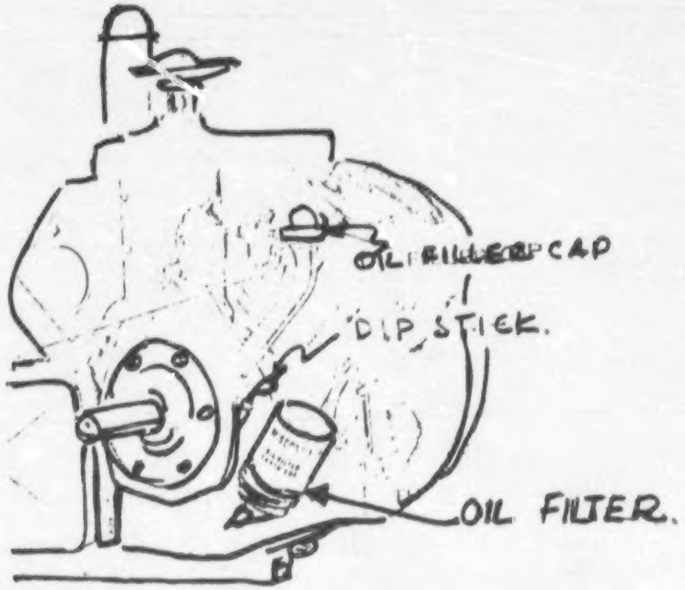
3. Oil clean the engine: As it circulates, oil washes the internal parts and picks up impurities resulting from combustion. The impurities are removed from the oil as it circulates through the oil filter.

oil cleans

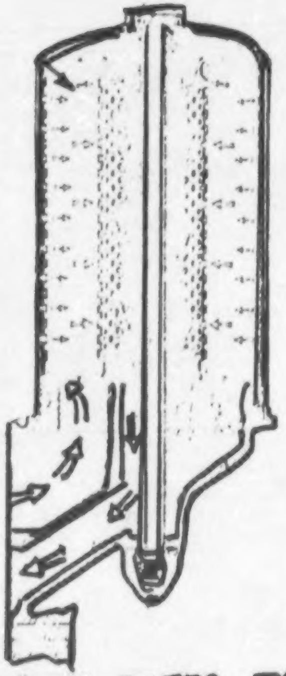
4. Oil provides the seal between piston rings and cylinder wall.

oil seals

OIL HELPS CLEAN THE ENGINE

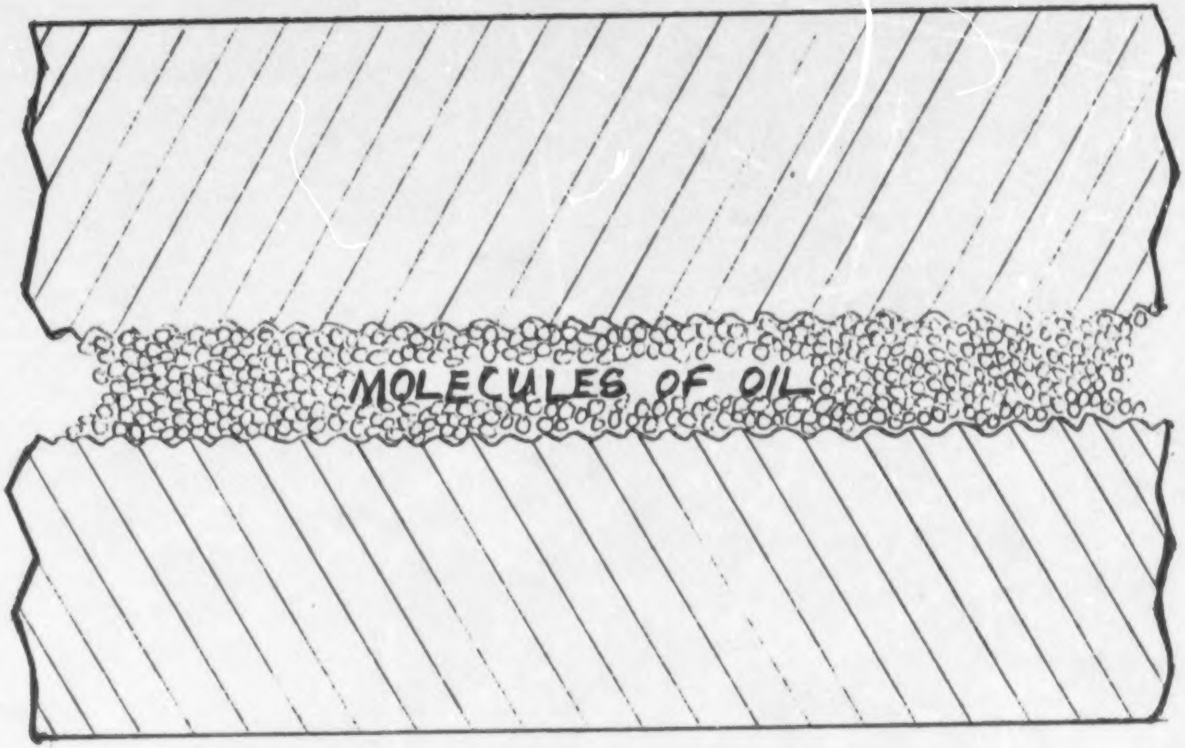


357 AN OIL FILTER TRAPS CONTAMINANTS PICKED UP BY ENGINE OIL



358 CUTAWAY OF OIL FILTER. THE ARROWS SHOW THE FLOW OF OIL THROUGH THE OIL FILTER.

OIL LUBRICATES



Sample Test

Purpose of Lubrication System

TEST

Explain the four things that lubricating oil does for an engine.

1.

2.

3.

4.

Sample Lesson Plan

UNIT XIV COOLING SYSTEM - Small Engine I

Sub-Unit #2: Types of Cooling System(2 & 4 cycle)

Unit: One type (water cool outboard motor)

Objective #2: Identify the types of cooling systems and describe how one works(2-cycle and 4-cycle)

Teacher Activities:

Lecture

a. Water inlet and screen - allow the coolant in and filterize it

b. Water pump - pump water from outside into powerhead

1. Impeller
2. Impeller key and plate
3. Housing and grommet

c. Water tube - transmit water to powerhead

d. Thermostat - regulate a constant temperature for the engine

Procedure

a. List down names of parts of the cooling system

b. Explain their functions

c. Show parts as explained (transparencies)

d. Use engine to show locations of each part

e. Take the cooling system off and trace the flow of water in the system

f. Review and give handout

Student Activities:

a. Read text (Outboard Motor Service Manual) pages 5-3, 6-2, & 6-9

b. Participation in class, disassembling and assembling of the cooling system.
c. Discussion of parts operation
d. Take test

Instructional Aids:

a. Charts - Outboard Marine Corporation
b. Demonstration of model in class
c. Handouts
d. Service Manual (OMC Service Manual, pp. 5-3, 6-2, & 6-9
e. Transparencies
f. Chalk & board

HANDOUT

COOLING SYSTEM

The cooling not only cools but have a termperature controlled system. This control mechanism is called a thermostat. The thermostat controls a constant operating temperature throughout the operation of the motor, increasing motor life and efficiency.

The thermostat housing is part of the cylinder head. When starting a cold motor the thermostat prevents the water to be circulated in the cooling system. This is done by a bleed hole in the thermostat valve. As soon as the powerhead and cooling system termperature reaches 145°F the thermostat valve opens. The heated water passes through the water discharge and the fresh water is drawn through the water intake. The thermostat continues to provide powerhead temperature by a periodical opening and closing of the thermostat valve.

List of parts:

1. Thermostat valve
2. Water intake and screen
3. Water pump

    a. Impeller
    b. Impeller key
    c. Housing and plate
    d. Grommet

4. Tube
5. Water discharge outlet

Test

MULTIPLE CHOICE: (Circle the best answers)

1. The part that filters the coolant before entering the whole cooling system is the:

   a. Impeller housing b. Thermostat c. Water inlet screen

2. Three components of the water pump are:

   a. Impeller, Grommet and thermostat
   b. Housing, Grommet and Impeller
   c. Impeller, housing and tube

3. Regulates a constant temperature for the engine:

   a. water outlet b. water pump c. thermostat

4. Transmission of coolant is done by:

   a. impeller b. water pump c. water tube

MATCHING (Match the word with the explanation that fits best)

5. ______ Let the hot water into the sea.

6. ______ Pump coolant into the powerhead

7. ______ Filter coolant before entering engine.

8. ______ Keep a constant temperature (or the engine)

a. thermostat
b. water inlet screen
c. water outlet
d. pump

Suggested Textbooks

1. Alfred C. Roth, Small Gasoline Engine, The Goodheart-Willcox Company, Inc., 1975
2. Outboard Marine Corp., Johnson Outboards Service Manual, Waukegan, Illinos, 1977
3. Jud Purvis, All About Small Gas Engines, The Goodheart-Willcox Company, Inc., 1963

BIBLIOGRAPHY

BIBLIOGRAPHY

POWER MECHANICS

1. Pipe, Ted. Small Gasoline Engines. Indianapolis, Indiana, Howard W. Sams & Co., Inc., 1973.

2. Boh, Ralph C. and Angus J. MacDonald. Power: Mechanics of Energy Control. Bloomington, Illinois, McKnight & McKnight Publishing Co., 1970.

3. Roth, Alfred C. Small Gas Engines. South Holland, Illinois, The Goodheart-Willcox Co., Inc., 1975.

4. Hires, Bill; Taylor, Mark; and Mike Bundy. Comprehensive Small Engine Repair. Mid-American Vocational and Technical Education, 1977.

5. Stephenson, George E. Small Gasoline Engines. Albany, New York, Delmar Publishing, 1964.

BIBLIOGRAPHY

Auto Mechanics I

1. Barr & Flacco. The Automotive Electrical System. Chilton Book Company, Philadelphia, New York, London, 1968.

2. Billet, Walter. Automotive Engine Maintenance & Repair. American Technical Society, New Jersey, Director, Office of Area Vocational Technical Schools, New York, St. Louis, 1971.

3. Crouse, William. Automotive Chasis & Body Construction Operation and Maintenance. McGraw-Hill Book Company, New York, St. Louis, 1971.

4. ________. Automotive Electrical Equipment. McGraw-Hill Book Company, New York, St. Louis, 1971.

5. Duff, Joseph. Power Prime Mover of Technology. McKnight & McKnight Publishing Company, Bloomington, Illinois, 1972.

6. Hill, Harry. Automotive Service & Repair Tools. Delmar Publishing Albany, New York, 1975.

7. Johnson, Larry. Fix Your Volkswagon. The Goodheart-Willcox Company, Inc., South Holland, Illinois, 1973.

8. Kelly, John. Jeep Universal. Chilton Book Company, Radnor, Pennsylvania, 1973.

9. Larew, Walter. Carburetor & Carburetion. Chilton Book Company, Philadelphia, New York, London, 1967.

10. ________. Ignition System. Chilton Book Company, Philadelphia, New York, London, 1968.

11. Ludwig, Oswald and Willard McCarty. Metal Work. McKnight & McKnight Publishing Company, Bloomington, Illinois, 1969.

12. Ritch, Ocee. Chilton's Honda Repair and Tune-Up Guide. Chilton Book Company, London, 1971.

13. Spicer, Edward. Automotive Collision Work. American Technical Society, Chicago, U.S.A., 1972.

14. Steele, Gerald. Fiber Glass. McKnight & McKnight Publishing Co., Bloomington, Illinois, 1962.

15. Stockel, Martin. Auto Mechanics Fundamentals. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1974.

16. Stockel, Martin. *Auto Service and Repair*. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1978.

17. ______________. Modern Welding. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1970.

18. Venk, Ernest. *Automotive Fundamentals*. American Technical Society, Chicago, U.S.A., 1967.

19. Walker, John. *Explaining Metal Working*. The Goodheart-Willcox, Co., Inc., South Holland, Illinois, 1972.

20. ___________. Machining Fundamentals. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1969.

BIBILIOGRAPHY

Auto Mechanics II

1. Attenbery, Pat. Power Mechanics. The Goodheart-Willcox Co., South Holland, Illinois, 1968.
2. Crouse, William. The Auto Book. 2nd ed. McGraw-Hill Book Co., New York, New York, 1979.
3. ______________. Automotive Mechanics. McGraw-Hill Book Co., New York, New York, 1970.
4. ______________. Automotive Mechanics, 7th ed. McGraw-Hill Book Co., New York, New York, 1975.
5. Kelly, John. Auto Troubleshooting Guide. Chilton Book Co., Rodnor, Pennsylvania, 1973.
6. Purvis, Jud. Small Gasoline Engine. The Goodheart-Willcox Co., South Holland, Illinois, 1968.
7. Stockel, Martin. Auto Mechanics Fundamentals. The Goodheart-Willcox Co., South Holland, Illinois, 1974.
8. ______________. Auto Service and Repair. The Goodheart-Willcox Co., South Holland, Illinois, 1978.
9. Toboldt, William. Automotive Encyclopedia. The Goodheart-Willcox Co., South Holland, Illinois, 1972.
10. Woodward, Robert. Industrial Art Power Mechanics. California State Department of Education, Sacramento, California, 1970.

BIBLIOGRAPHY

Auto Mechanics III

1. Althouse, A.D., C. H. Turnguist, and W. A. Bowditch. Modern Welding. Goodheart-Willcox Co., Inc.,South Holland, Illinois, 1970.

2. Armstrong, Ivan J. Auto Mechanics. Stillwater, Oklahoma, State Department of Vocational Education, 1976.

3. Crouse, William H. Automotive Mechanics. McGraw-Hill Book Company, New York, St. Louis, 1970.

4. Hobson, W. T. Automotive Refinishing Principles and Techniques. McFarland and Co., 1976.

5. Stockel, Martin W. Auto Mechanics Fundamentals. Illinois, Goodheart-Willcox Co., Inc., 1974.

6. Tait, J.A., A. G. Deroche, and N. N. Hildebrand. The Principles of Autobody Repairing and Repainting. Prentice-Hall, Inc., New Jersey, 1971.

7. Toboldt, William K. and Larry Johnson. Automotive Encyclopedia. Goodheart-Willcox, Inc., 1972.

BIBLIOGRAPHY

SMALL ENGINES

1. The Aerospace Education Foundation. Automobile/Truck Mechanic. 1750 Pennsylvania Ave., N. S. Washington, D. C., 1969.

2. Briggs and Stratton. Briggs and Stratton Repair Instruction. Briggs & Stratton Corp., Milwaukee, Wisconsin.

3. Stockel, Martin W. Auto Service and Repair. The Goodheart-Willcox, Co., Inc., 1978.

4. Mid-America Vocational Curriculum Consortium. Comprehensive Small Engine Repair. State Department of Vocational and Technical Education, Stillwater, Oklahoma, 1977.

5. Oklahoma State Board of Vocational and Technical Education. General Mechanical Trades. State Department of Vocational and Technical Education, Stillwater, Oklahoma, 1971.

6. Outboard Marine Corp. Johnson Outboards Service Manual. Johnson Outboards, Waukegan, Illinois, 1977.

7. Purvis, Jud. Small Gas Engine. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1963.

8. Roth, Alfred C. Small Gasoline Engine. The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1975.

9. State of Hawaii. Industrial Arts, Instructional Guide For Power. Office of Instructional Services, Department of Education, State of Hawaii, 1975.

10. Stephenson, George E. Small Gasoline Engine. Van Nostrand Reinhold, Ltd., 1964.